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EOCENE FLORA.

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AND

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II. A CLASSIFIED LIST OF THE MONOGRAPHS COMPLETED, IN COURSE OF PUBLICATION, AND IN PREPARATION, WITH THE NAMES OF THEIR RESPECTIVE AUTHORS;

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V. A STRATIGRAPHICAL LIST OF THE BRITISH FOSSILS FIGURED AND DESCRIBED IN THE YEARLY VOLUMES.

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Vol. I.	Issued for the Year	1847	The Crag Mollusca, Part I, Univalves, by Mr. S. V. Wood, 21 plates.
„ II.	„	1848	The Reptilia of the London Clay, Vol. I, Part I, Chelonia, &c., by Profs. Owen and Bell, 38 plates. The Eocene Mollusca, Part I, Cephalopoda, by Mr. F. E. Edwards, 9 plates.
„ III.*	„	1849	The Entomostraca of the Cretaceous Formations, by Mr. T. R. Jones, 7 plates. The Permian Fossils, by Prof. Wm. King, 29 plates. The Reptilia of the London Clay, Vol. I, Part II, Crocodilia and Ophidia, &c., by Prof. Owen, 18 plates. The Fossil Corals, Part I, Crag, London Clay, Cretaceous, by Messrs. Milne Edwards and Jules Haime, 11 plates.
„ IV.	„	1850	The Crag Mollusca, Part II, No. 1, by Mr. S. V. Wood, 12 plates. The Mollusca of the Great Oolite, Part I, Univalves, by Messrs. Morris and Lycett, 15 plates. The Fossil Brachiopoda, Part III, No. 1, Oolitic and Liassic, by Mr. Davidson, 13 plates.
„ V.	„	1851	The Reptilia of the Cretaceous Formations, by Prof. Owen, 39 plates. The Fossil Corals, Part II, Oolitic, by Messrs. Milne Edwards and Jules Haime, 19 plates. The Fossil Lepadidæ, by Mr. Charles Darwin, 5 plates.
„ VI.	„	1852	The Fossil Corals, Part III, Permian and Mountain-limestone, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Brachiopoda, Part I, Tertiary, by Mr. Davidson, 2 plates. The Fossil Brachiopoda, Part II, No. 1, Cretaceous, by Mr. Davidson, 5 plates. The Fossil Brachiopoda, Part III, No. 2, Oolitic and Liassic, by Mr. Davidson, 5 plates. The Eocene Mollusca, Part II, Pulmonata, by Mr. F. E. Edwards, 6 plates. The Radiaria of the Crag, London Clay, &c., by Prof. E. Forbes, 4 plates.
„ VII.	„	1853	The Fossil Corals, Part IV, Devonian, by Messrs. Milne Edwards and Jules Haime, 10 plates. The Fossil Brachiopoda, Introduction to Vol. I, by Mr. Davidson, 9 plates. The Mollusca of the Chalk, Part I, Cephalopoda, by Mr. D. Sharpe, 10 plates. The Mollusca of the Great Oolite, Part II, Bivalves, by Messrs. Morris and Lycett, 8 plates. The Mollusca of the Crag, Part II, No. 2, Bivalves, by Mr. S. V. Wood, 8 plates. The Reptilia of the Wealden Formations, Part I, Chelonia, by Prof. Owen, 9 plates.

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CATALOGUE OF WORKS—Continued.

Vol. VIII.	Issued for the Year *1854	The Fossil Brachiopoda, Part II, No. 2, Cretaceous, with Appendix and Index to Vol. I, by Mr. Davidson, 8 plates. The Reptilia of the Wealden Formations, Part II, Dinosauria, by Prof. Owen, 20 plates. The Mollusca of the Great Oolite, Part III, Bivalves, by Messrs. Morris and Lycett, 7 plates. The Fossil Corals, Part V, Silurian, by Messrs. Milne Edwards and Jules Haime, 16 plates. The Fossil Balanidæ and Verrucidæ, by Mr. Charles Darwin, 2 plates. The Mollusca of the Chalk, Part II, Cephalopoda, by Mr. D. Sharpe, 6 plates. The Eocene Mollusca, Part III, No. 1, Prosobranchiata, by Mr. F. E. Edwards, 8 plates.
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,, XIV.	,, 1860	The Fossil Brachiopoda, Part V, No. 5, Carboniferous, by Mr. Davidson, 8 plates. The Reptilia of the Oolitic Formations, No. 2, Lower Lias, by Prof. Owen, 11 plates. The Reptilia of the Kimmeridge Clay, No. 2, by Prof. Owen, 1 plate. The Fossil Estheriæ, by Prof. Rupert Jones, 5 plates. The Fossil Crustacea, Part II, Gault and Greensand, by Prof. Bell, 11 plates.
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„ XVIII.	„ 1864	The Fossil Echinodermata, Oolitic, Vol. II, Part II (Liassic Ophiuroidea), by Dr. Wright, 6 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part III, by Mr. J. W. Salter, 11 plates. The Belemnitidæ, Part II, Liassic Belemnites, by Prof. Phillips, 7 plates. The Pleistocene Mammalia, Part I, Introduction, Felis spelæa, by Messrs. W. Boyd Dawkins and W. A. Sanford, 5 plates. Title-pages, &c., to the Monographs on the Reptilia of the London Clay, Cretaceous, and Wealden Formations.
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Vol. XXV*	Issued for the Year 1871		The Flora of the Carboniferous Strata, Part III, by Mr. E. W. Binney, 6 plates. The Fossil Merostomata, Part III, Pterygotus and Slimonia, by Mr. H. Woodward, 5 plates. Supplement to the Crag Mollusca, Part I (Univalves), by Mr. S. V. Wood, with an Introduction on the Crag District, by Messrs. S. V. Wood, jun., and F. W. Harmer, 7 plates and map. Supplement to the Reptilia of the Wealden (Iguanodon), No. IV, by Prof. Owen, 3 plates The Pleistocene Mammalia, Part IV, Felis pardus, &c., by Messrs W. Boyd Dawkins and W. A. Sanford, 2 plates. The Pleistocene Mammalia, Part V, Ovibos moschatus, by Mr. W. Boyd Dawkins, 5 plates.
,, XXVI.*	,,	1872	Supplement to the Fossil Corals, Part III (Oolitic), by Prof. Duncan, with an Index to the Tertiary and Secondary Species, 7 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part V, by Dr. Wright, 5 plates. The Fossil Merostomata, Part IV (Stylonurus, Eurypterus, Hemiaspis), by Mr. H. Woodward, 10 plates. The Fossil Trigoniæ, No. I, by Dr. Lycett, 9 plates.
,, XXVII.*	,,	1873	The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates. Supplement to the Fossil Brachiopoda, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates. Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates. Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates. Supplement to the Reptilia of the Wealden (Hylæochampsa) No. VI, by Prof. Owen. The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.
,, XXVIII*	,,	1874	The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, 16 plates. The Carboniferous Entomostraca, Part I (Cypridinadæ), by Prof. T. Rupert Jones and Messrs. J. W. Kirkby and G. S. Brady, 5 plates. The Fossil Trigoniæ, No. II, by Dr. Lycett, 10 plates.
,, XXIX*	,,	1875	The Flora of the Carboniferous Strata, Part IV, by Mr. E. W. Binney, 6 plates. The Fossil Echinodermata, Cretaceous, Vol. I, Part VII, by Dr. Wright, 10 plates. The Fossil Trigoniæ, No. III, by Dr. Lycett, 8 plates. The Fossil Reptilia of the Mesozoic Formations, Part II, by Prof. Owen, 20 plates.
,, XXX.*	,,	1876	The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady, 12 plates. Supplement to the Fossil Brachiopoda, Part II, No. 1 (Jurassic and Triassic), by Mr. Davidson, 8 plates. Supplement to the Reptilia of the Wealden (Poikilopleuron and Chondrosteosaurus), No. VII, by Prof. Owen, 6 plates.
,, XXXI.*	,,	1877	Supplement to the Eocene Mollusca (Bivalves), by Mr. S. V. Wood, 2 plates. The Fossil Trigoniæ, No. IV, by Dr. Lycett, 13 plates. The Eocene Mollusca (Univalves), Part IV, by Mr. S. V. Wood, 1 plate. The Carboniferous Ganoid Fishes, Part I (Palæoniscidæ), by Dr. Traquair, 7 plates. The Fossil Reptilia of the Mesozoic Formations, Part III, by Prof. Owen, 2 plates. The Fossil Elephants (E. antiquus), Part I, by Prof. Leith Adams, 5 plates.
,, XXXII.*	,,	1878	The Fossil Echinodermata, Cretaceous, Vol. I, Part VIII, by Dr. Wright, 8 plates. Index and Title Page to the Fossil Echinodermata, Oolitic, Vol. I (Echinoidea), by Dr. Wright. The Fossil Merostomata, Part V (Neolimulus, &c.), by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Part II, No. 2 (Jurassic and Triassic), by Mr. Davidson, 13 plates. The Lias Ammonites, Part I, by Dr. Wright, 8 plates. The Sirenoid and Crossopterygian Ganoids, Part I, by Prof. Miall, 6 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Petrosuchus, and Suchosaurus), No. VIII, by Prof. Owen, 6 plates. The Pleistocene Mammalia, Part A (Preliminary Treatise), by Prof. Boyd Dawkins.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope.

CATALOGUE OF WORKS—Continued.

Vol. XXXIII*	Issued for the Year 1879	The Eocene Flora, Part I, by Mr. J. S. Gardner and Baron Ettingshausen, 5 plates. Second Supplement to the Crag Mollusca (Univalves and Bivalves), by Mr. S. V. Wood, 6 plates. The Fossil Trigoniæ, No. V (*Conclusion*), by Dr. Lycett, 1 plate. The Lias Ammonites, Part II, by Dr. Wright, 10 plates. Supplement to the Reptilia of the Wealden (Goniopholis, Brachydectes, Nannosuchus, Theriosuchus, and Nuthetes), No. IX, by Prof. Owen, 4 plates. The Fossil Elephants (E. primigenius), Part II, by Prof. Leith Adams, 10 plates.
„ XXXIV*	„ 1880	The Eocene Flora, Part II, by Mr. J. S. Gardner and Baron Ettingshausen, 6 plates. The Fossil Echinodermata, Oolitic, Vol. II, Part III (Asteroidea and Ophiuroidea), by Dr. Wright, 3 plates. Supplement to the Fossil Brachiopoda, Part III (Permian and Carboniferous), by Mr. Davidson, 8 plates. The Lias Ammonites, Part III, by Dr. Wright, 22 plates. The Reptilia of the London Clay, Vol. II, Part I (Chelone) by Prof. Owen, 2 plates.
„ XXXV*	„ 1881	The Fossil Echinodermata, Cretaceous, Vol. I, Part IX, by Dr. Wright, 6 plates. Supplement to the Fossil Brachiopoda, Part IV (Devonian and Silurian, from Budleigh-Salterton Pebble Bed), by Mr. Davidson, 5 plates. The Fossil Trigoniæ (Supplement No. 1), by Dr. Lycett. The Lias Ammonites, Part IV, by Dr. Wright, 10 plates. The Reptilia of the Liassic Formations, Part III (*Conclusion*), by Prof. Owen, 13 plates. The Fossil Elephants (E. primigenius and E. meridionalis), Part III (*Conclusion*), by Prof. Leith Adams, 13 plates.
„ XXXVI*	„ 1882	The Eocene Flora, Vol. I, Part III (*Conclusion*), by Mr. J. S. Gardner and Baron Ettingshausen, 2 plates. Third Supplement to the Crag Mollusca, by the late Mr. S. V. Wood, 1 plate. The Fossil Echinodermata, Cretaceous, Vol. I, Part X (*Conclusion*), by Dr. Wright, 5 plates. Supplement to the Fossil Brachiopoda, Vol. IV, Part V (*Conclusion*), by Dr. Davidson. Supplement to the Fossil Brachiopoda, Vol. V, Part I (Devonian and Silurian), by Dr. Davidson, 7 plates. The Lias Ammonites, Part V, by Dr. Wright, 22 plates.
„ XXXVII*	„ 1883	The Eocene Flora, Vol. II, Part I, by Mr. J. S. Gardner, 9 plates. The Trilobites of the Silurian, Devonian, &c., Formations, Part V (*Conclusion*), by the late Mr. J. W. Salter. The Carboniferous Trilobites, Part I, by Dr. H. Woodward, 6 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part II (Silurian), by Dr. Davidson, 10 plates. The Fossil Trigoniæ (Supplement No. 2), by the late Dr. Lycett, 4 plates. The Lias Ammonites, Part VI, by Dr. Wright, 8 plates.
„ XXXVIII*	„ 1884	The Eocene Flora, Vol. II, Part II, by Mr. J. S. Gardner, 11 plates. The Carboniferous Entomostraca, Part I, No. 2 (*Conclusion*), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady, 2 plates. The Carboniferous Trilobites, Part II, by Dr. H. Woodward, 4 plates. Supplement to the Fossil Brachiopoda, Vol. V, Part III (*Conclusion*), by Dr. Davidson, 4 plates. The Lias Ammonites, Part VII, by Dr. Wright, 10 plates.

* These Volumes are issued in two forms of binding; first, with all the Monographs stitched together and enclosed in one cover; secondly, with each of the Monographs separate, and the whole of the separate parts placed in an envelope.

§ II. LIST OF MONOGRAPHS

Completed, in course of Publication, and in Preparation.

1. MONOGRAPHS which have been COMPLETED, and which may be bound as separate Volumes:—

The Eocene Flora, Vol. I, by Mr. J. S. Gardner and Baron Ettingshausen. (*Complete in the Volumes for the years* 1879, 1880, *and* 1882. *Title-page, Index, and directions for the binding, will be found in the Volume for* 1882.)

The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady. (*Complete in the Volume for the year* 1876.)

The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime. (*Complete in the Volumes for the years* 1849, 1851, 1852, 1853, *and* 1854. *The Title-page and Index, with corrected explanations of Plates XVII and XVIII, will be found in the Volume for the year* 1854.)

The Polyzoa of the Crag, by Mr. G. Busk. (*Complete with Title-page and Index in the Volume for the year* 1857.)

The Tertiary Echinodermata, by Professor Forbes. (*Complete with Title-page in the Volume for the year* 1852.)

The Fossil Cirripedes, by Mr. C. Darwin. (*Complete in the Volumes for the years* 1851, 1854, *and* 1858. *The Title-page will be found in the Volume for the year* 1854, *and the Index in the Volume for the year* 1858.

The Post-Tertiary Entomostraca, by Mr. G. S. Brady, the Rev. H. W. Crosskey, and Mr. D. Robertson. (*Complete, with Title-page and Index, in the Volume for the year* 1874.)

The Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1855.)

The Cretaceous Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1849.)

The Carboniferous Entomostraca, Part I (Cypridinadæ and their allies), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady. (*Complete, with Title-page and Index, in the Volume for the year* 1884.)

The Fossil Estheriæ, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year* 1860.)

The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter. (*Complete in the Volumes for the years* 1862, 1863, 1864, 1866, *and* 1883. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1883.)

The Fossil Merostomata, by Dr. H. Woodward. (*Complete in the Volumes for the years* 1865, 1868, 1871, 1872, *and* 1878. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1878.)

The Fossil Brachiopoda (Tertiary, Cretaceous, Oolitic, and Liassic), Vol. I, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1850, 1852, 1853, *and* 1854. *The Index will be found in the Volume for the year* 1854, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Permian and Carboniferous), Vol. II, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1856, 1857, 1858, 1859, *and* 1860. *The Index will be found in the Volume for the year* 1860, *and corrected Title-page in that for* 1870.)

The Fossil Brachiopoda (Devonian and Silurian), Vol. III, by Mr. T. Davidson. (*Complete in the Volumes for the years* 1862, 1863, 1865, 1866, 1868, *and* 1870. *The Title-page and Index will be found in the Volume for the year* 1870.)

The Fossil Brachiopoda, Vol. IV, by Dr. T. Davidson. Supplements: Tertiary, Cretaceous, Jurassic, Triassic, Permian, and Carboniferous. *Complete in the Volumes for the years* 1873, 1876, 1878, 1880, 1881, *and* 1882. *The Title-page and Index, with directions for the binding will be found in the Volume for the year* 1882.)

The Fossil Brachiopoda, Vol. V, by Dr. T. Davidson. Supplements: Devonian and Silurian. Appendix to Supplements, General Summary, Catalogue and Index of the British Species. (*Complete in the Volumes for the years* 1882, 1883, *and* 1884. *The Title-page, with directions for the binding will be found in the Volume for* 1884.)

The Eocene Bivalves, Vol. I, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volumes for the years* 1859, 1862, *and* 1870. *The directions for the binding will be found in the Volume for the year* 1870.)

Supplement to the Eocene Bivalves, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1877.)

The Eocene Cephalopoda and Univalves, Vol. I, by Mr. F. E. Edwards and Mr. S. V. Wood. (*Complete in the Volumes for the years* 1848, 1852, 1854, 1855, 1858, *and* 1877. *The Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1877.)

The Mollusca of the Crag, Vol. I, Univalves, by Mr. S. V. Wood. (*The Text, Plates, and Index, will be found in the Volume for the year* 1847, *and the Title-page will be found in the Volume for the year* 1855.)

The Mollusca of the Crag, Vol. II, Bivalves, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1850, 1853, 1855, 1858, *and* 1873. *The Title-page will be found in the Volume for the year* 1873, *and the Index will be found in the Volume for the year* 1855, *and a Note in the Volume for the year* 1858).

The Mollusca of the Crag, Vol. III, Supplement, by Mr. S. V. Wood. (*Complete in the Volumes for the years* 1871 *and* 1873. *The Title-page and Index will be found in the Volume for the year* 1873.)

Second Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1879.)

Third Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year* 1882.)

The Great Oolite Mollusca, by Professor Morris and Dr. Lycett. (*Complete in the Volumes for the years* 1850, 1853, *and* 1854. *The Title-page and Index will be found in the Volume for the year* 1854.)

The Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1872, 1874, 1875, 1877, *and* 1879. *The directions for the binding will be found in the Volume for the year* 1879.)

Supplement to the Fossil Trigoniæ, by Dr. Lycett. (*Complete in the Volumes for the years* 1881 *and* 1883. *The Title-page, Index, with directions for the binding, will be found in the Volume for the year* 1883.)

The Oolitic Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1855, 1856, 1857, 1858, *and* 1878. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1878.)

The Oolitic Echinodermata, Vol. II, Asteroidea, by Dr. Wright. (*Complete in the Volumes for the years* 1861, 1864, *and* 1880. *Title-page, Index, and directions for the binding, will be found in the Volume for the year* 1880).

The Cretaceous Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years* 1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, *and* 1882. *The Title-page and Index, with directions for the binding, will be found in the Volume for the year* 1882.)

The Cretaceous (Upper) Cephalopoda, by Mr. D. Sharpe. (*Complete in the Volumes for the years* 1853, 1854, *and* 1855, *but wants Title-page and Index.*)

The Fossils of the Permian Formation, by Professor King. *Complete, with Title-page and Index, in the Volume for the year* 1849. *Corrected explanations of Plates XXVIII and XXVIII* will be found in the Volume for the year* 1854.)

The Reptilia of the London Clay (and of the Bracklesham and other Tertiary Beds), Vol. I, by Professors Owen and Bell. (*Complete in the Volumes for the years* 1848, 1849, 1856, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Cretaceous Formations, by Prof. Owen. (*Complete in the Volumes for the years* 1851, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-page, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Wealden and Purbeck Formations, by Professor Owen. (*Complete in the Volumes for the years* 1853, 1854, 1855, 1856, 1857, 1858, 1862, *and* 1864. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1864.)

The Reptilia of the Liassic Formations, by Professor Owen. (*Complete in the Volumes for the years*, 1859, 1860, 1863, 1869, *and* 1881. *Directions for the binding, Title-pages, and Index, will be found in the Volume for the year* 1881.)

The Fossil Mammalia of the Mesozoic Formations, by Professor Owen. (*Complete, with Title-page and Table of Contents, in the Volume for the year* 1870.)

The Fossil Elephants, by Professor Leith Adams. (*Complete in the Volumes for the years* 1877, 1879, *and* 1881. *Directions for the binding, Title-page, and Index will be found in the Volume for the year* 1881.

2. MONOGRAPHS in course of PUBLICATION :†—

The Eocene Flora, by Mr. J. S. Gardner.
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.
Supplement to the Fossil Corals, by Dr. Duncan.
The Trilobites, by Dr. H. Woodward.
Supplement to the Fossil Brachiopoda, by Dr. T. Davidson.
The Ammonites of the Lias, by Dr. Wright.
The Belemnites, by Professor Phillips.*
The Sirenoid and Crossopterygian Ganoids, by Professor Miall.
The Fishes of the Carboniferous Formation, by Prof. Traquair.
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, and Professor Traquair.
The Reptilia of the Wealden Formation (Supplements), by Professor Owen.
The Reptilia of the Kimmeridge Clay, by Professor Owen.
The Reptilia of the Mesozoic Formations, by Professor Owen.
The Pleistocene Mammalia, by Messrs. Boyd Dawkins and W. A. Sanford.
The Cetacea of the Crag, by Professor Owen.

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3. MONOGRAPHS which are in course of PREPARATION :— †

The Fossil Cycadeæ, by Mr. W. Carruthers.
The Carboniferous Flora, by Prof. Williamson.
The Stromatoporoids, by Prof. H. Alleyne Nicholson.
The Rhizopoda of the Chalk, Chalk Marl, Gault, and Upper Greensand, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.
The Foraminifera of the Lias, by Mr. H. B. Brady.
The Polyzoa of the Chalk Formation, by Mr. G. Busk.
The Carboniferous Entomostraca, Part II (Leperditiadæ), by Messrs. T. Rupert Jones, J. W. Kirkby, and G. S. Brady.
The Cretaceous Asteroidea, by Dr. Wright.
Supplement to the Tertiary and Cretaceous Entomostraca, by Prof. T. Rupert Jones.
The Wealden, Purbeck, and Jurassic Entomostraca, by Messrs. T. R. Jones and G. S. Brady.
The Cretaceous Mollusca (exclusive of the Brachiopoda), by the Rev. Prof. T. Wiltshire.
The Purbeck Mollusca, by Mr. R. Etheridge.
The Jurassic Gasteropoda, by Mr. Hudleston.
The Rhætic Mollusca, by Mr. R. Etheridge.
The Carboniferous Bivalve Mollusca, by Mr. R. Etheridge, junr.
The Inferior Oolite Ammonites, by Prof. Buckman.
The Silurian Fish Bed, by Dr. Harley.

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* Unfinished through the death of the Author, but will be continued by Mr. R. Etheridge.

† Members having specimens which might assist the authors in preparing their respective Monographs are requested to communicate in the first instance with the Honorary Secretary.

§ III. Dates of the Issue of the Yearly Volumes of the Palæontographical Society.

Volume	I	for	1847	was	issued	to	the	Members, March, 1848.
„	II	„	1848	„	„	„		July, 1849.
„	III	„	1849	„	„	„		August, 1850.
„	IV	„	1850	„	„	„		June, 1851.
„	V	„	1851	„	„	„		June, 1851.
„	VI	„	1852	„	„	„		August, 1852.
„	VII	„	1853	„	„	„		December, 1853.
„	VIII	„	1854	„	„	„		May, 1855.
„	IX	„	1855	„	„	„		February, 1857.
„	X	„	1856	„	„	„		April, 1858.
„	XI	„	1857	„	„	„		November, 1859.
„	XII	„	1858	„	„	„		March, 1861.
„	XIII	„	1859	„	„	„		December, 1861.
„	XIV	„	1860	„	„	„		May, 1863.
„	XV	„	1861	„	„	„		May, 1863.
„	XVI	„	1862	„	„	„		August, 1864.
„	XVII	„	1863	„	„	„		June, 1865.
„	XVIII	„	1864	„	„	„		April, 1866.
„	XIX	„	1865	„	„	„		December, 1866.
„	XX	„	1866	„	„	„		June, 1867.
„	XXI	„	1867	„	„	„		June, 1868.
„	XXII	„	1868	„	„	„		February, 1869.
„	XXIII	„	1869	„	„	„		January, 1870.
„	XXIV	„	1870	„	„	„		January, 1871.
„	XXV	„	1871	„	„	„		June, 1872.
„	XXVI	„	1872	„	„	„		October, 1872.
„	XXVII	„	1873	„	„	„		February, 1874.
„	XXVIII	„	1874	„	„	„		July, 1874.
„	XXIX	„	1875	„	„	„		December, 1875.
„	XXX	„	1876	„	„	„		December, 1876.
„	XXXI	„	1877	„	„	„		February, 1877.
„	XXXII	„	1878	„	„	„		March, 1878.
„	XXXIII	„	1879	„	„	„		May, 1879.
„	XXXIV	„	1880	„	„	„		May, 1880.
„	XXXV	„	1881	„	„	„		May, 1881.
„	XXXVI	„	1882	„	„	„		June, 1882.
„	XXXVII	„	1883	„	„	„		October, 1883.
„	XXXVIII	„	1884	„	„	„		December, 1884.

§ IV. SUMMARY OF THE MONOGRAPHS ISSUED TO THE MEMBERS (*up to* DECEMBER, 1884): *showing in the* FIRST *column whether each Monograph hitherto published be* complete, *or in the* course of completion; *in the* SECOND *column, the yearly volumes which contain each particular Monograph (as a guide to binding the same); and in the* FOURTH *and following columns, the number of pages, plates, figures, and species described in the different Monographs.*

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Flora of the Eocene Formations, by Mr. J. S. Gardner and Baron Ettingshausen. Vol. I, COMPLETE	1879, 1880, 1882	1879, 1880, 1882	87	13	151	23
" " by Mr. J. S. Gardner. Vol. II, *in course of completion*...	1883, 1884	1883, 1884	92	20	343	26
The Flora of the Carboniferous Strata, by Mr. E. W. Binney, *in course of completion*	1867, 1870, 1871, 1875	1868, 1871, 1872, 1875	147	24	141	16
The Crag Foraminifera, by Messrs. T Rupert Jones, W. K. Parker, and H. B. Brady, *in course of completion*	1865	1866	78	4	211	43
The Carboniferous and Permian Foraminifera (genus Fusilina excepted), by Mr. H. B. Brady, COMPLETE	1876	1876	166	12	266	62
Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime, COMPLETE (*k*)	1849, 1851, 1852, 1853, 1854	1850, 1851, 1852, 1853, 1855	406	72	800	319*g*
Supplement to the Fossil Corals, by Prof. Duncan, *in course of completion*	1865, 1866, 1867, 1868, 1869, 1872	1866, 1867, 1868, 1869, 1870, 1872	232	49	797	149
The Polyzoa of the Crag, by Mr. G. Busk, COMPLETE	1857	1859	145	22	641	122
The Tertiary Echinodermata, by Prof. Forbes, COMPLETE	1852	1852	39	4	144	44
The Oolitic Echinodermata, by Dr. Wright. Vol. I, COMPLETE (*l*)	1855, 1856, 1857, 1858, 1878	1857, 1858, 1859, 1861, 1878	491	43	724	120*h*
" " Vol. II, COMPLETE	1861, 1864, 1880	1863, 1866, 1880	207	22	232	35
The Cretaceous Echinodermata, by Dr. Wright. Vol. I, COMPLETE	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1864, 1868, 1870, 1871, 1872, 1874, 1875, 1878, 1881, 1882	390	87	1119	113
The Fossil Cirripedes, by Mr. C. Darwin, COMPLETE	1851, 1854, 1858*a*	1851, 1855, 1861	137	7	320	54
The Fossil Merostomata, by Dr. H. Woodward, COMPLETE	1865, 1868, 1871, 1872, 1878	1866, 1869, 1872, 1872, 1878	265	36	365	51
The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, COMPLETE	1874	1874	237	16	515	134
The Tertiary Entomostraca, by Prof. Rupert Jones, COMPLETE	1855	1857	74	6	233	56
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE	1849	1850	41	7	176	27
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estheriæ, by Prof. Rupert Jones, COMPLETE	1860	1863	139	5	158	19*i*
		CARRIED FORWARD...	3468	456	7710	1494

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
		BROUGHT FORWARD...	3468	456	7710	1494
The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter, COMPLETE	1862, 1863, 1864, 1866, 1883	1864, 1865, 1866, 1867, 1883	224	31	703	114
The Carboniferous Trilobites, by Dr. H. Woodward, COMPLETE	1883, 1884	1883, 1884	86	10	148	31
The Malacostracous Crustacea (comprising those of the London Clay, Gault, and Greensands), by Prof. T. Bell, *in course of completion*	1856, 1860	1858, 1863	88	22	215	50
The Fossil Brachiopoda, Vol. I. The Tertiary, Cretaceous, Oolitic, and Liassic Brachiopoda, by Mr. T. Davidson, COMPLETE	1850, 1852, 1853, 1854	1851, 1852, 1853, 1855	409	42	1855	160
„ „ Vol. II. The Permian and Carboniferous Brachiopoda, COMPLETE	1856*d*, 1857, 1858, 1859, 1860	1858, 1859, 1861, 1861, 1863	331	59	1909	157
„ „ Vol. III. The Devonian and Silurian Brachiopoda, COMPLETE	1862, 1863, 1865, 1866, 1868, 1870	1864, 1865, 1866, 1867, 1869, 1871	528	70	2766	321
„ „ Vol. IV. Supplements, Tertiary to Carboniferous, COMPLETE	1873, 1876, 1878, 1880, 1881, 1882	1874, 1876, 1878, 1880, 1881, 1882	383	42	1664	215
„ „ Vol. V. Supplements, Devonian and Silurian, COMPLETE	1882, 1883, 1884	1882, 1883, 1884	476	21	1135	116
The Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1872, 1874, 1875, 1877, 1879	1872, 1874, 1875, 1877, 1879	246	41	446	115
Supplement to the Fossil Trigoniæ, by Dr. Lycett, COMPLETE	1881, 1883	1881, 1883	19	4	53	9½
The Mollusca of the Crag, by Mr. S. V. Wood:— Vol. I. (Univalves), COMPLETE	1847, 1855*b*	1848, 1857	216	21	581	244
Vol. II. (Bivalves), COMPLETE	1850, 1853, 1855, 1858*c*	1851, 1853, 1857, 1861	344	31	691	253
Supplements to the Crag Mollusca, No. I and II, by Mr. S. V. Wood, COMPLETE	1871, 1873, 1879	1872, 1874, 1879	322	18	517	232
„ „ No. III „ COMPLETE	1882	1882	24	1	29	13
The Eocene Mollusca, Cephalopoda and Univalves, by Mr. F. E. Edwards, continued by Mr. S. V. Wood. Vol. I, COMPLETE	1848, 1852, 1854, 1855, 1858, 1877	1849, 1852, 1855, 1857, 1861, 1877	361	34	625	275
The Eocene Mollusca, Bivalves, by Mr. S. V. Wood. Vol. I, COMPLETE	1859, 1862, 1870	1861, 1864, 1871	182	25	531	194
Supplement to the Eocene Mollusca, by Mr. S. V. Wood (Bivalves). Vol. I, COMPLETE	1877	1877	24	2	66	30
The Great Oolite Mollusca, by Prof. Morris and Dr. Lycett, COMPLETE	1850, 1853, 1854	1850, 1853, 1855	282	30	846	419
„ „ „ Supplement by Dr. Lycett, COMPLETE	1861	1863	129	15	337	194
The Liassic Ammonites, by Dr. Wright, *in course of completion*	1878, 1879, 1880, 1881, 1882, 1883, 1884	1878, 1879, 1880, 1881, 1882, 1883, 1884	480	90	722	105
The Belemnites, by Prof. Phillips, *in course of completion*	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
		CARRIED FORWARD...	8750	1101	24,171	4810

I. SUBJECT OF MONOGRAPH.	II. Dates of the Years *for which* the volume containing the Monograph was issued.	III *m*. Dates of the Years *in which* the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
		BROUGHT FORWARD...	8750	1101	24,171	4810
The Upper Cretaceous Cephalopoda, by Mr. D. Sharpe, COMPLETE	1853, 1854, 1855	1853, 1855, 1857	67	27	319	79
The Fossils of the Permian Formation, by Prof. King, COMPLETE	1849, 1854*e*	1850, 1855	287	29	511	138
The Sirenoid Ganoids, by Prof. Miall, *in course of completion*	1878	1878	32	6	61	6
The Fishes of the Carboniferous Formation, by Dr. Traquair, *in course of completion*	1877	1877	60	7	58	5
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, *in course of completion*	1867, 1869	1868, 1870	62	14	195	21
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I, COMPLETE‡	1848, 1849, 1856*f*	1849, 1850, 1859	150	58	304	39
„ „ Vol. II, Part I, by Prof. Owen, *in course of completion*	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE‡	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations, by Prof. Owen, COMPLETE ‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden Formations (Supplements) *in course of completion*	1871, 1873, 1876, 1878, 1879	1872, 1874, 1876, 1878, 1879	81	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, *in course of completion*	1859, 1860, 1868	1861, 1863, 1869	16	6	23	3
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,‖ 1860,‖ 1863, 1869, 1881*n*	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, *in course of completion*	1873, 1875, 1877	1874, 1875, 1877	97	24	165	17
The Crag Cetacea, by Prof. Owen, *in course of completion*	1869	1870	40	5	43	7
The Fossil Elephants, by Prof. Leith Adams, COMPLETE	1877, 1879, 1881*n*	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, *in course of completion*	1864, 1867, 1868, 1871, 1878	1866, 1868, 1869, 1872, 1878	304	32	253	7
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1870	1871	115	4	247	30
		TOTAL.....	10,843	1535	27,791	5244

a Index. *b* Title-page to Univalves. *c* Note to Crag Mollusca. *d* Contains the Permian. *e* Two corrections of Plates. *f* Supplement.
g Many of the species are described, but not figured. *h* British species only reckoned. *i* British species only reckoned. *k* A Supplement is now in course of publication.
l Index will be found in 1878 vol. *m* Useful for establishing the dates of new species. *n* Contains title-pages and directions for binding.
‡ Title-pages and Index will be found in the 1864 Volume, or may be had separately. ‖ Marked on outside label 'Reptilia of Oolitic Formations.'

§ V. STRATIGRAPHICAL TABLE *exhibiting the* BRITISH FOSSILS *already figured and described in the* ANNUAL VOLUMES (1847—1884) *of the* PALÆONTOGRAPHICAL SOCIETY.

	PLANTS.	PROTOZOA.		RADIATA.		ARTICULATA.					
		Sponges.	Foraminifera.	Corals.	Echinodermata.	Cirripedes.	Cypridæ, Cytherinæ, &c.	Estheriæ.	Merostomata.	Trilobites.	Malacostracous Crustacea.
Pleistocene	...	...	...	...	.....	.....	1874				
Crag	...	...	1865	1849	1852	1851, 1854					
Eocene	1879, 1880, 1882, 1883, 1884	...	...	1849, 1865	1852	1851, 1854	1855	...	.....	.....	1856
Cretaceous.....	...	...	...	1849, 1868, 1869	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1851, 1854	1849	...	.....	.....	1860
Wealden	...	...	...	...	.....	.....	...	1860			
Oolitic	...	...	...	1851, 1872	1855, 1856, 1857, 1858, 1861, 1878, 1880	1851	...	1860			
Liassic	...	...	...	1851, 1866, 1867	1855, 1856, 1858, 1861, 1864						
Triassic	...	...	...	...	1880	.....	...	1860			
Permian	1849	1849	1849, 1876	1849, 1852	1849	.....	1849	1860			
Carboniferous...	1867, 1870, 1871, 1875	...	1876	1852	.....	.....	1874, 1884	1860	1872, 1878	1883, 1884	
Devonian	...	...	...	1853	.....	.....	...	1860	1865, 1868, 1872, 1878	1862	
Silurian.....	...	...	...	1854	.....	.....	...	...	1868, 1871, 1872, 1878	1862, 1863, 1864, 1866	
Cambrian	...	...	...	...	.....	.....	...	...	.....	1864	

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates.

STRATIGRAPHICAL TABLE *exhibiting the* BRITISH FOSSILS *already figured and described in the* ANNUAL VOLUMES (1847—1884) *of the* PALÆONTOGRAPHICAL SOCIETY (*continued*).

	MOLLUSCA.				VERTEBRATA.		
	Polyzoa.	Brachiopoda.	Monomyaria, Dimyaria, and Gasteropoda.	Cephalopoda.	Fishes.	Reptiles.	Mammalia.
Pleistocene	...	1873	.....	...	...	.....	1864, 1867, 1868, 1871, 1877, 1878, 1879, 1881
Crag	1857	1852, 1873, 1879	1847, 1850, 1853, 1855, 1871, 1873, 1879, 1882	...	...	.....	1869, 1881
Eocene	...	1852, 1873	1852, 1854, 1855, 1858, 1859, 1862, 1870, 1877	1848	...	1848, 1849, 1856, 1880	
Cretaceous.....	...	1852, 1854, 1873, 1884	1872, 1875, 1877, 1879	1853, 1854, 1855	...	1851, 1857, 1858, 1862	
Wealden	...	... ..	.....	...	...	1853, 1854, 1855, 1856, 1857, 1862, 1871, 1873, 1875, 1876, 1878, 1879	
Oolitic	...	1850, 1852, 1876, 1878, 1884	1850, 1853, 1854, 1872, 1874, 1875, 1877, 1879, 1883	1850, 1861, 1868, 1869	...	(Purbeck) 1853, 1858 (Kim. Clay), 1859, 1860, 1868, 1873, 1875, 1877 (Great Oolite) 1875	1870
Liassic	...	1850, 1852, 1876, 1878, 1884	1874, 1877, 1879, 1883	1863, 1864, 1866, 1868, 1878, 1879, 1880, 1881, 1882, 1883, 1884	...	1859, 1860, 1863, 1869, 1873, 1881	
Triassic.....	...	1876, 1878	1879	.....	1878	.....	1870
Permian	1849	1849, 1856, 1880	1849	1849	1849	1849	
Carboniferous ...	...	1856, 1857, 1858, 1859, 1860, 1880, 1884	.....	.....	1877		
Devonian	...	1862, 1863, 1881, 1882, 1884	.....	.....	1867, 1869		
Silurian.....	...	1865, 1866, 1868, 1870, 1881, 1882, 1883					
Cambrian							

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates.

THE

PALÆONTOGRAPHICAL SOCIETY.

INSTITUTED MDCCCXLVII.

VOLUME FOR 1884.

LONDON:
MDCCCLXXXIV.

A MONOGRAPH

OF THE

BRITISH EOCENE FLORA.

BY

JOHN STARKIE GARDNER, F.L.S., G.S., M.G.S. France, &c.

VOL. II. PART II.

GYMNOSPERMÆ.

Pages 61–92; Plates X–XX.

LONDON:

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

1884.

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J. E. ADLARD, BARTHOLOMEW CLOSE.

the London Clay, they are generally macerated and abraded. They appear, without exception, to be unripe, or have not shed their seed, and may have travelled long distances before becoming finally waterlogged and embedded. It is therefore open to question whether the Pines from which they were derived were actually indigenous to our Eocene plains or low-lying grounds during the sub-tropical periods, or whether they might not, from the great length of time they would float, have been brought from more hilly countries by river, or even from other lands by marine currents.

The genus Cedrus comprises four species, or perhaps varieties, which inhabit respectively the Himalayas, the Lebanon, Atlas, and Cyprus mountains. The cones are globose and erect on the upper side of the branches. The scales are thin, leathery, and closely pressed together, and persist for some time after shedding the seed. The cones break up and the scales fall separately, except those of the apex, which are soldered together in form of a rosette. This habit may account for the complete absence of fossil Cedars in the Tertiaries; the older forms known from the Neocomian having possibly possessed persistent scales. Sections of Coniferous wood are figured in 'Dixon's Geology of Sussex,' pl. xvi, fig. 5, which were redescribed by Carruthers, ed. ii, p. 164, as *Cedroxylon Worthingense*. Picea has twelve to twenty-four species, with solitary acicular leaves and cones resembling those of the Cedar. They inhabit temperate regions throughout the northern hemisphere, almost to the confines of vegetation. Two Gault forms from Hainault are doubtfully referred to the genus, while fossil species are met with in Iceland and Greenland, the Wetterau Amber-beds, and a few other Miocene (?) localities. Tsuga resembles Picea, but possesses terminal and pendant cones. The five species inhabit Japan, the Himalayas, and North America, and are said to have been found fossil in the same beds as Picea. I have some doubtful cones from the Iron-ores of Ballypalady described at page 74 as *Tsuga Heerii*. *Pinus Crameri*, related to Tsuga, is the most widely spread fossil in the Arctic Cretaceous. The only species of Pseudotsuga inhabits from Mexico to Oregon. The eighteen species of Abies inhabit mountainous regions of northern and north-temperate regions. The scales are leathery and loosely imbricated and not persistent, as in Tsuga. Fossil species are known from the Jurassic and Wealden, and from Greenland, Iceland, and the European Miocenes (?). Larix possesses seven to ten species, with linear leaves, solitary or in bundles, and deciduous in all but one species. The cones are small, with leathery persistent scales, and fall in clusters with the dead branches. The Larch extends over the colder regions of Europe, Asia, and America. Three fossil species are described from the Miocene of Frankfort, and one from Austria.

Several of the *Abietineæ*, including the common Spruce, formed part of the British Flora in the Pliocene age, for their remains are met with in the Clays at Bacton, Norfolk. All died out, however, owing to unknown causes, except the Scotch Fir, truly indigenous in the Highlands, and were re-introduced by the agency of man.

Genus—PINUS, *Linn.*

The flowers are monœcious; the male flowers are produced in dense clusters or spikes at the extremities of the branches, and the female flowers either solitary or in whorls. The cones are ovate, conical, or oblong, generally sessile, persistent for a long while, solitary or in clusters, and varying in size from that of a walnut to a length of nineteen inches or even more. The scales are spirally disposed, numerous, woody or subligneous, generally thickened at the apex, persistent, closely imbricated, and gaping when ripe. The seeds are in pairs, two under each scale, and are more or less oval and pseudo-samaroid, or rarely wingless. The leaves are acicular, sometimes very long, and in sheaves of two, three, or five. The subdivisions, "Binæ," "Ternatæ," and "Quinæ," founded on the number of leaves in a fasciculus, and generally adopted as a basis of classification, are rejected by Bentham and Hooker as being based upon an inconstant character. The two natural sections, PINASTER and STROBUS, may be distinguished, the first by the woody nature of its cones, with scales closely pressed together before dehiscence, the heads rendered more or less quadrate by this mutual pressure, and with raised or depressed areola, and central umbo or mucro. The indigenous Scotch Pine, the introduced Maritime Pine, and nearly all the Pines of Europe, belong to this section. The Strobus Pines have cones of loosely-imbricated concave scales, leathery in texture, thickest in the middle and thin at the margins, and with minute or obsolete umbos. The Himalayan *P. excelsa*, *P. Lambertiana*, or the Sugar Pine, *P. strobus*, and *P. cembra*, are examples of the group.

The *Pinaster* section contains sixty or seventy recent species, and Schimper enumerates a still larger number fossil. The oldest forms are from Solenhofen; and the Gault of Hainault contains, according to Coemans, connecting links between the two sections.

Strobus appears to possess not more than thirteen living, and about twenty fossil species, the oldest of which is from the Neocomian of Greenland.

Pines are confined, like all the Abietineæ, to the Northern Hemisphere, but stretch into the neotropical region along the mountains of Mexico. They are quite absent from the Ethiopian and Australian regions, though one species ranges to Java.

Notwithstanding its exclusion from southern regions it has the widest range of any genus of forest trees, for it extends from the perpetual snows of the Arctic Regions to Mexico, where it mingles on the high grounds with Feather-palms, and to the southernmost points of Europe and Asia. A single species, *P. sylvestris*, stretches from latitude 70° in North Lapland and 65° 15′ in East Siberia to 36° in Persia, thus reaching over at least 34° of latitude and 150° of longitude. Frequently two species of Pine mingle to form

vast forests; and again species replace each other at varying heights, as on the Riesengebirge, where four different species of Pines and Firs inhabit separate zones.

Fig. 24.

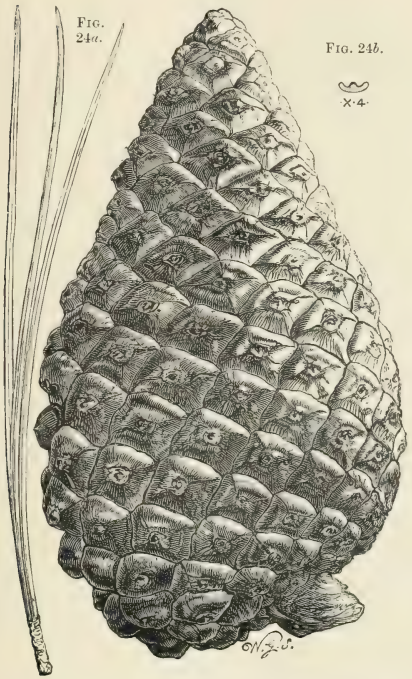


Fig. 24.—A Cone of *Pinus insignis* (of the *Pinaster* section), nat. size. *a*, leaves, nat. size; *b*, section of leaf, magnified 4 diameters. From the 'Gardener's Chronicle.'

Fig. 25.

Fig. 25.—A Cone of *Pinus koraiensis* (of the *Strobus* section), natural size. From Veitch's 'Manual of the Coniferæ.'

Pinus macrocephalus, *Lindley and Hutton*, sp. Plate XIV, figs. 1, 2, 6, 7.

Zamia macrocephala, *Lindl. & Hutt.* Foss. Flora, vol. ii, p. 117, pl. 125, 1833–35.
Zamiostrobus macrocephalus, *Endlicher.* Gen. Plant., p. 72, 1836–40.
Zamites — *Morris.* Ann. Nat. Hist., ser. i, vol. vii, p. 116, 1841.
Pinites — *Brongn.* Dict. univ. d'Hist. Nat., p. 317, 1849; Ann. des Sc. Nat., ser. iii, vol. xi, p. 285, 1849.
Zamiostrobus Henslowii, *Miquel.* Monogr. Cycad., p. 75, 1861.
Pinites macrocephalus, *Carr.* Geol. Mag., vol. iii, p. 5, pl. xx, 1866; and Journ. Bot., p. 10, pl. xviii, 1867.

Thanet Beds, East Kent.

The cones are cylindrical, slightly tapering, blunt at both ends, and measure from eleven to thirteen centimètres in length by some fifty-five millimètres in breadth. They possess a somewhat slender axis, about five millimètres in diameter, from which the scales are given off at first at obtuse angles, and then, just beyond the seeds, bend sharply upwards with a slightly outward direction. The terminations of the scales are large, roughly hexagonal, ten millimètres thick, and about thirteen millimètres in diameter. Their surfaces are smooth and unornamented, but slightly convex towards the centre of the upper portion of the scale. Each scale supports two seeds in the hollowed inferior surface near its base, about half an inch long, and possibly wingless. A remarkable character about this and the following species is that the basal scales are larger than those of the body. Mr. Carruthers describes them as "barren, and the apophyses rise from their whole surface; in the series immediately above them there is a short flat body to the scale, but the greater portion of the scale is covered with the apophysis; the third series are fertile and have a longer and more ascending body." The cone has externally a cycadean aspect, but internally the structure is that of a true Pine. Corda appears to have first recognised its true nature in 1846,[1] and three years later Brongniart, having apparently received a specimen from Mr. Wetherell, still more positively stated, from the form and direction of the scales and the position of the double seeds at their base, that it was the cone of a Pine and not of a Cycad. The great size of the basal scales suffices to distinguish it from all existing Pines, but this character alone scarcely seems to warrant our placing the species in the doubtful genus *Pinites*, in which many of the Secondary Coniferæ find an appropriate place. Carruthers compares it to *Pinus pinea*, a very solid, bluntly ovate cone, five or six inches in length, containing large shortly-winged seeds, inhabiting the Mediterranean borders from Spain to Greece.

The fossils, through some vagueness as to their exact derivation, were once thought to be Cretaceous, but they are undoubtedly Eocene. Mr. Dowker showed me a very fine specimen which he obtained in a pit of nearly pure sand just above the Infirmary of the Canterbury Barracks, which was unfossiliferous at the time of my visit.

The specimen (fig. 7) is stated by Henslow[2] to have been "discovered in cleaning out a pond four miles from Deal, on the road to Canterbury." Mr. Dowker has, however, I believe, found more than one specimen *in situ*, and is able to fix their precise horizon in the Thanet Beds, near Reculvers.

[1] Reuss, 'Verst. d. Boehm. Kreidef.,' 1846.

[2] Lindley and Hutton, 'Foss. Flora,' p. 117.

PINUS OVATA, *Lindley and Hutton*, sp. Plate XIV, figs. 4 and 5.

ZAMIA OVATA, *Lindl. & Hutt.* Foss. Flor., vol. iii, p. 189, pl. 226*a*, 1837.
ZAMITES — *Morris.* Ann. Nat. Hist., ser. i, vol. vii, p. 116, 1841.
ZAMIOSTROBUS OVATUS, *Goepp.* Uebersicht. d. Arbeit d. Schles. Ges., p. 129, 1844.
PINITES — *Carr.* Geol. Mag., vol. iii, p. 9, pl. xx, 1866; and Journ. Bot., pl. xviii, 1867.

Thanet Beds, East Kent.

The cone closely resembles *P. macrocephalus*, but differs in its smaller size and more ovate form. The specimen is imperfect at the base, but it seems to have possessed large basal scales like the last. The apophyses of the scales are more lozenge-shaped than hexagonal, and longer than broad. Carruthers had before him the transverse section, Pl. XIV, fig. 4, which exhibits "a slender axis, the centre of which is occupied with cellular tissue, and is surrounded by a cylinder of wood. Being transverse, the section cannot exhibit the disc on the vascular tissue, but it exactly agrees with transverse sections of recent cones. A regular series of large ducts are arranged symmetrically around the axis. Each scale supports two seeds. The tissue of these has entirely disappeared, the cavity being filled with carbonate of lime. Three other scales are seen beyond that bearing the seeds in section." The history of the species is similar to that of the last. The seeds seem rounder, and it is possibly a distinct species, though from beds of the same age. Mr. Richardson is said to have found it on the coast near Faversham. Owing to some curious misunderstanding it is recorded by Schimper as from a rearranged deposit near Lyme Regis, but probably of Tertiary age.

PINUS PRESTWICHII, sp. nov. Plate XIII, fig. 3.

ABIES SP., *Prestwich.* Quart. Journ. Geol. Society, vol. x, p. 156, pl. iii, fig. 3, 1854.

Thanet Beds, Herne Bay.

The cone is elongate, ninety-four millimètres in length, cylindrical, and tapers gradually from the widest part, twenty-one millimètres, to a very acute apex, and rather more suddenly to a small truncated base. The scales are flattened, without any trace of prominence or keels, and marked with irregular longitudinal striæ, either parallel or slightly diverging at the base. Their impressions are sub-hexagonal or with the upper margin rounded; the umbo must have been apical, and there are slight indications on one or two scales that it may have been mucronate. Their extreme width is twelve to

fourteen millimètres, and the height visible in the impressions but eight millimètres. The unique specimen known is a hollow mould in so small a concretion of ferruginous sandstone that the walls are only some five to seven millimètres thick. Inside this there was a lignitic core, casts of which have been made, though they are of little if any palæontological value. The mode of fossilisation is exceptional and difficult to understand, for the partings between the scales are incised on the mould instead of elevated, and the surfaces of the scales themselves somewhat convex, as if the walls of the mould had bulged as the vegetable tissue of the cone shrank away.

Fig. 26.—*Pinus monticola* (from 'Veitch's Manual,' p. 181).

The fossil clearly belongs to the Strobus section of Pines, and the species with which it is most comparable are *P. peuce*, growing in European Turkey at elevations of 5000 and 6000 feet,—*P. monticola* of Northern California, a species growing on Trinity Mountain at an elevation of 7000 feet, and on the banks of rivers in Oregon and Washington Territory,—*P. strobus* of Canada to Virginia, and *P. excelsa* of the Himalayas, at elevations of 6000 to 12,000 feet. All these are quite hardy, and the presence of the fossil in the Thanet Beds is therefore corroborative of the relatively temperate climate of that period.

I am not acquainted with any fossil cone sufficiently near it to enable a useful comparison to be made. The original specimen in still in Professor Prestwich's collection, and I am indebted to him for the opportunity of describing and refiguring it.

Pinus Dixoni, *Bowerbank*, sp. Plate XIII, figs. 1, 2, 4, 5, 8.

Pinites Dixoni, *Bowerbank*. In Dixon's Geol. Sussex, ed. 1, p. 84, pl. ix. fig. 3, 1850.
— — — Ibid., ed. 2, p. 162, 1878.

Middle Bagshot, Bracklesham; Bembridge Marls, Gurnet Bay, Isle of Wight.

The specimen originally figured is still preserved in the Botanical Department of the British Museum, though in a very imperfect state. It was described by Carruthers[1] as

[1] Dixon, 2 ed., p. 162.

"elongated, sub-cylindrical, swollen towards the base; five inches long, one and a half broad on the upper half. Scales thickened at the apex, with a rhomboidal obtusely spinous apophysis." Fig. 8, Plate XIII, represents a rather obscure specimen from the Fisher collection in the Woodwardian Museum, Cambridge, and shows the apophyses to be rhomboidal, transversely carinated, and umbonate; it measures about fifteen centimètres in length, by seven or eight centimètres across, having at least ten scales to a whorl. When redescribing Dixon's specimen, Mr. Carruthers remarked that "on the left side, and at the base, the cone has been abraded, the apices being lost, so that in estimating the form of the perfect cone allowance must be made for the missing parts. It is obvious that, when these scales were perfect, the diameter of the cone must have been considerably greater at the base than is shown in the figure." It is difficult, however, even making full allowance for their imperfect condition, to reconcile the very long cylindrical form reproduced in the woodcut Fig. 27, with the pyramidal outline of Fig. 8, Pl. XIII.

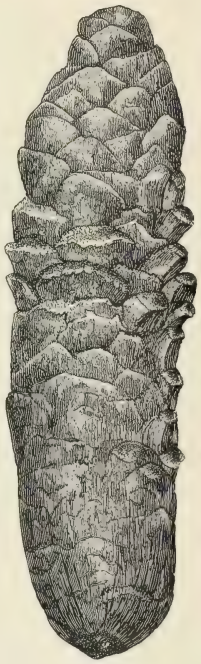


Fig. 27.—*P. Dixoni*; Bracklesham. Dixon's 'Geol. Sussex.'

A smaller and better-preserved specimen, from the Woodwardian Museum, Pl. XIII, figs. 1 and 2, represents almost the entire cone, with a length of eighty-five millimètres, and a breadth of forty millimètres, composed of about 112 scales. The form is ovate, but a slight allowance has to be made for compression. The apophyses of the scales are very similar to those of *P. sylvestris;* the largest measures twelve millimètres by eight millimètres. Another specimen, in the British Museum, labelled from the Isle of Wight, but which must apparently have been obtained either at Highcliff or Bracklesham, has even smaller apophyses, almost suggesting another species, to which the small axis from Highcliff, Pl. XIII, fig. 5, may also have belonged.

The larger cone, Pl. XIII, fig. 4, obtained by Mr. J. A'Court Smith, from Gurnet Bay, near Cowes, presents no characters which allow it to be separated specifically from *Pinus Dixoni*, of the Bracklesham Beds. The scales were more widely dehiscent than in the other examples, and their apophyses are in every case abraded, except towards the top of the cone, where they are almost concealed by pyrites. When visible in this and in a second specimen, however, they are seen to be quite similar to those above described. What remains of the cone is six inches long, nearly cylindrical, somewhat pointed at the apex, obtusely rounded at the base, and composed of fourteen whorls of about ten scales.

It is, perhaps, worth remarking that all the Bracklesham and the two Gurnet Bay

cones have lost their basal scales, as if they had suffered decay on land or abrasion in rapidly moving streams before reaching salt water.[1]

The fossils bear a considerable resemblance to *Pitys Haidingeri*, pl. xix, 'Unger Chloris Protogæa,' p. 73, from Leoben in Styria, and very little doubt can exist as to their identity with *Pinus Defrancii*,[2] Ad. Brongn., from the "Calcaire grossier," of Arcueil, in the Paris Basin. *Pinus hordeacea*, Rossner, from Tschnernowitz, in Bohemia, is also not dissimilar.

The nearest existing species seem to be *P. laricio*, *P. pyrenaica*, and *P. halepensis*, Pines belonging essentially to the Mediterranean region.

P. Dixoni, if all the specimens are correctly placed in the same species, would range from the Bracklesham to high up in the Bembridge Marls, but it is not improbable that a good series of more perfect specimens might lead to the recognition of more than one species.

PINUS BOWERBANKII, *Carr.*, sp. Plate XIII, figs. 6 and 9; Plate XIV, figs. 3 and 8.

PINITES DIXONI, *Bowerbank* (pars). In Dixon's Geology of Sussex, ed. 1, p. 84, pl. ix, fig. 4, 1850.
— BOWERBANKII, *Carruthers*. Ibid., ed. 2, p. 163, 1878.
PINUS SHEPPEYENSIS, *Ett. & Gard.* Proc. Royal Society, No. 198, 1879.

London Clay, Sheppey; Middle Bagshot, Bracklesham and Highcliff.

This Pine is so far only known from very mutilated specimens, and the original example figured in the 'Geology of Sussex' no longer exists. Dixon's figure does not in all probability exhibit the true apices of the scales, for they are represented merely as bluntly recurved, without umbo, but considerably thickened, forming a type of scale unknown in the genus *Pinus*. The similarity in the breadth and form of the scales and of the cone generally have induced me to unite with it a specimen in which a few scales are perfect; they are of somewhat crescentic form, two centimètres broad, transversely keeled, and with small recurved mucronate umbo.

Mr. Carruthers, in separating it from *P. Dixoni*, Bow., described it as "ovate (?) or oblong (?). Scales very large, broad, and cuneate; apex broad, flat, and with a recurved edge; covered part of the scale large, and deeply imbricated." He also suggests that it might be only the upper portion of a very large and long cone, but I scarcely think this can have been the case, and I am inclined to believe that nearly the entire axis is present in the specimen figured in Plate XIII, fig. 9.

[1] Whether the decay is due to such causes, or to the ravages of birds or squirrels, the basal scales are the first to suffer.

[2] 'Mém. du Mus. d'Hist. Nat., vol. viii, p. 325, pl. 17, fig. 8, *a*, *b*.

The Sheppey specimens are still more fragmentary, and add nothing to our knowledge of the size and external form of the cone, and only one presents a few perfect scales. These are also about two centimètres broad, and with heads resembling those of the Bracklesham specimen (Pl. XIII, fig. 9). Other specimens (Pl. XIV, figs. 3 and 8) show a very stout axis marked deeply with pear-shaped scars and rather large and winged seeds. The fragment (Pl. XIII, fig. 6) from Highcliff doubtless belongs to the same or a very similar species.

Fig. 28.—*P. Bowerbankii*. 'Dixon's Geology of Sussex,' edit. 2.

The resemblance between the Bracklesham and the Sheppey and Highcliff specimens, justify, in the absence of any distinguishing specific characters, their being grouped under one name. Whether they should be united with *P. Bowerbankii*, of Carruthers, is far more open to question, and indeed, if Dixon's figure were an absolutely reliable representation, it would be manifestly improper to do so; but I know from experience how difficult it is to interpret and restore an imperfect and abraded cone in the condition of soft and perishable lignite, and I think that with our present material the multiplication of species is best avoided. The late Dr. Bowerbank remarked on the difference between Dixon's two specimens from Bracklesham, but abstained from separating them specifically.

Carruthers places it in the *Cembra* division of Strobus, distinguished by its wingless seeds; and Bowerbank considered both the Bracklesham Pines to be allied to the tender *P. Russelliana* of Mexico. The specimens I have united with it, however, clearly belong to the Pinaster section of the genus.

It is rare at Bracklesham, but Mr. Keeping tells me that cones are occasionally abundant at Highcliff. It is also very rare at Sheppey, where the presence of seeds *in situ* shows that the cones were not originally deposited in a mutilated condition.

Pinus Plutonis, *Baily*. Plate XV, figs. 1, 3, 4, 6, 7, 8; Plate XVI, figs. 5—7, and 17; Plate XVII, except fig. 4; and Plate XVIII.

Pinus Plutonis, *Baily*. Quart. Journ. Geol. Soc., vol. xxv, p. 360, pl. xv, 1869.
— Graingeri, *Baily*. Report of Brit. Association, pl. ii, 1880.

Basaltic Formation, Ballypalady, Antrim.

The remains of this fine species are very perfect and abundant.

The cones vary from seventy to ninety millimètres in length and twenty to thirty millimètres in diameter,—are cylindrical, tapering slightly towards the apex, rounded or rarely truncate at base,—and composed of between 120 and 140 scales. The scales are about twenty-five millimètres long, and ten to fifteen wide, but much smaller towards the extremities; the heads are sub-hexagonal or rounded on the upper margin, wider than high, flattened, with slightly elevated but distinct transverse ridges across the centre, culminating in a small, lozenge-shaped umbo, with traces of an ill-defined central tubercle. The cones are usually detached, more rarely in twos, and in the fine specimen (Pl. XV, fig. 3) obtained by Mr. Stewart, F.L.S., for the Belfast Museum, three are clustered together, appearing to grow upward and parallel to the stem. The seeds are oval and moderately large, about five millimètres in length or twenty millimètres, including their almost parallel-sided, rectangular wing (Pl. XVII, figs. 2, 3, 5, 8). The leaves are two in a sheath, rather slender, from ten to fifteen centimètres in length, and are often found in dense tufts adhering to the branchlets. The branchlets (Pl. XV, figs. 3 and 4) are closely inlaid with crowded and symmetrical leaf-scars, exhibiting the usual seasonal variations. A fragment of bark with larger scars is represented (fig. 7 of the same plate).

The scales of the cones are mostly closed, in which case very little lignitic matter remains, and the specimens are in the form of compressed hollow cavities exhibiting perfect moulds of the exterior of the cone. The example upon which *P. Graingeri* was founded was merely the shrunken lignitic matter out of one of these cavities. In other cases the cones had gaped, and the matrix has infiltrated between the scales, either filling the spaces left vacant by the shedding of the seeds, or replacing them with soft mud, prior to the decay of the woody tissue of the cone itself. Some examples found in this condition are certainly cones of *Pinus Plutonis*, for impressions of the thickened ends of the scales can be traced out, but in the specimens figured (Pl. XVI, figs. 5, 6, 7, 17), I have been unable to trace any thickening, and either therefore their more solid parts decayed while the matrix was too plastic to retain an impression, or the cones had thin scales and were allied to *Tsuga*. Their size and general form, and that of the seed, favour the former alternative. Heer described in 1855 cones similarly preserved in white sandstone from the Lausanne Tunnel (*Pinus Lardyana*, 'Flora Tert. Helv.,' vol. i, p. 58, pl. xx, fig. 5), and those I have figured from Sheppey (Pl. XIV, figs. 3 and 8) illustrate a stage in the process of decay in which nothing of the cone remains but the clustered seeds and the axis. In the Ballypalady cones a further stage has been reached in which the axis also has disappeared, and only casts of the seed-cavities remain. In this condition little resemblance to Pine cones is at first sight apparent, except the arrangement of the seeds in pairs. Cones in this condition have obviously no palæontological interest, and I should barely have referred to them were it not probable that similar specimens from Greenland have been mistaken for cones of Magnolia. Two such, brought from Greenland by Mr. Whymper (Heer, 'Flor. foss.

Arctica,' vol. ii, p. 478, pl. li, figs. 2 and 3, reprinted from the 'Phil. Trans.,' 1869), bear a striking resemblance to the Ballypalady Pine cones, while possessing little or no structure to support a contrary view.

The fruit of Magnolia consists of a number of carpels or follicles in a compact spike, which open along their outer edge to allow of the escape of the seed. In *Magnolia grandiflora*, to which the fossil is compared, the deciduous sepals and petals leave deep scars in falling away, forming a characteristic region on the stem immediately beneath the fruit, and the seeds are arranged not spirally, but horizontally in whorls, at right angles to the axis. The characteristic impress of a Magnolia fruit, whether the carpels were dehiscent or not at the time, would be the external, and not an internal cast, such as those met with in Greenland. Heer, in describing them, only says that the cones are "much resembling those of Magnolia," and that several of the "carpels show the fissure, precisely as in *Magnolia glauca*." The supposed fruits were not found in the same locality with the supposed leaves. It is easy to see how the division between two pine seeds might be mistaken for a fissure, and it is not impossible that the previous determination of Magnolia leaves may have led to an identification that might otherwise not have suggested itself. The specimens were unfortunately not returned, and the question of their true nature therefore remains open,—a fact to be regretted, since much stress had been laid on their presence to support the rather excessive estimate of the mildness of climate in high latitudes during the Tertiary period.

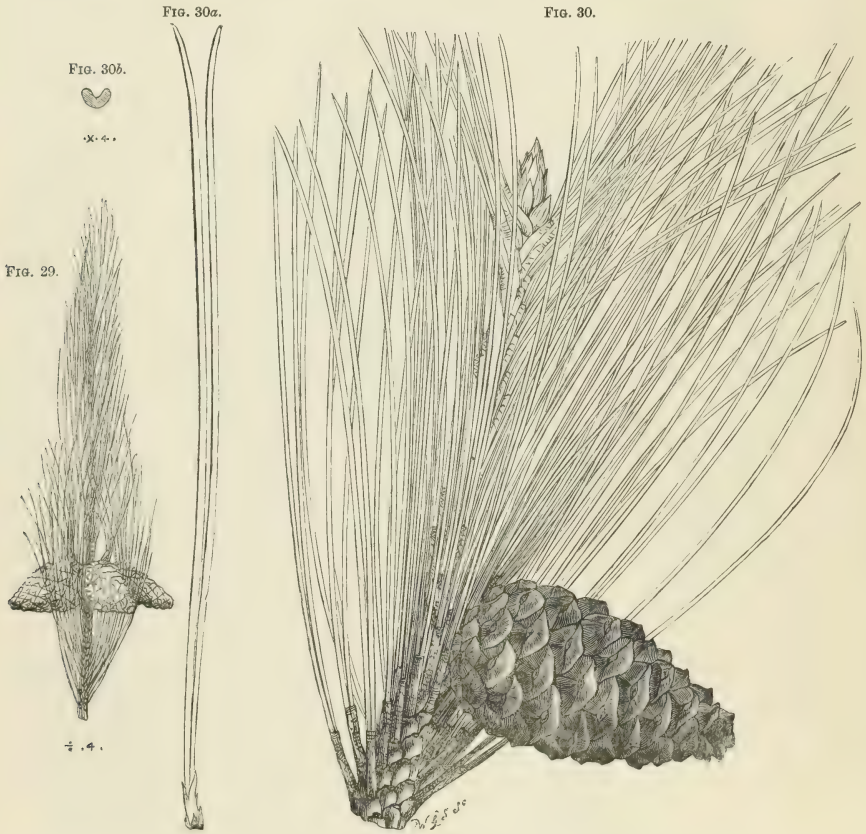
Pinus Plutonis bears the greatest resemblance to the less hardy of the living species of Pine. *Pinus sinensis*, of Hong Kong, differs chiefly in its slightly smaller cones and seeds, and more slender needles. *Pinus laricio*, an inhabitant of the Mediterranean and of Western Asia, varies in the more pyramidal form of its cones and the greater size of the heads of its scales, the needles and the scars left by them on the branchlets being nearly identical. *Pinus halepensis* is identical with it in the size and ornamentation of its cones and scales; but, while our cones are less pyramidal and apparently grow in an upward direction (Pl. XV, fig. 3), those of *P. halepensis* grow in pairs inversely downwards. The seed-wings of the fossil (Pl. XVII, figs. 2, 3, 8), are more rectangular and less obliquely truncated at the extremity than are any of those of the existing Pines which otherwise resemble it. The needles are very much the same as those of *P. halepensis*, and perhaps a trifle more slender than those of *P. laricio*. Our fossil must thus be regarded as a different, but closely allied species, and requiring probably a similar mean temperature.

P. halepensis is usually a low-spreading tree in habit, from twenty to thirty feet in height, though some of its varieties form much loftier trees, and ripens its cones in the autumn of the second year. It is common in the Mediterranean region of Europe and Asia Minor, but is not found north of the Apennines nor at elevations above 2000 feet.

Ettingshausen has endeavoured to trace a genetic connection between the Pines of the various Tertiary formations of Austria, especially of Leoben in Styria[1] and existing

[1] 'Beitr. zur Erforschung der Phylog. der Pflanzelementen,' 1877.

Pines. He divides the formations into four horizons, the oldest of which is characterised by, among others, *P. palæo-laricio*, the second by *P. hepios*, and the third and fourth by *P. laricio*. He gives no illustrations of the cones of the former species, but our seeds



Figs. 29, 30.—Fertile branchlet of *Pinus austriaca*; 29, one fourth natural size; 30, natural size; 30*a*, leaves, natural size; 30*b*, section of leaf, magnified 4 diam. (From the 'Gardener's Chronicle.')

agree more closely with those figured than with any existing seed. The fossil that appears most close to it is a cylindrical cone from Kumi in Eubœa, figured as *Pinus hampeana*.[1] The seeds and cone, as figured, differ in several respects, however, from those of *P. Plutonis*, and from Unger's earlier description of the species.

[1] Unger, 'Foss. Flor. Kumi,' pl. ii, fig. 13.

Pinus Bailyi, sp. nov. Plate XV, figs. 2, 5, 9; Plate XVII, fig. 4.

Basaltic Formation, Ballypalady, Antrim.

This species is far less abundant than the preceding. The cones are small, elongate, cylindrical, slightly curved, fifty-three millimètres in length, sixteen millimètres in diameter, without footstalks, obtuse at both ends, and composed of about sixty-five or seventy scales. The heads of the scales are sub-hexagonal, very flattened, and without any transverse keel or other ornament except an inconspicuous central umbo and some slight longitudinal striæ. The largest scale-head measures nine millimètres across and eight millimètres in height, and the sizes diminish towards the extremities. The shorter needles found at Ballypalady are in pairs and from five to eight centimètres in length (Pl. XVII, fig. 4), and, like the tufted branchlets (Pl. XV, fig. 2) and the slender branchlet (fig. 9), may belong to this species.

The characters that serve to distinguish it from *Pinus Plutonis* are quite apparent, and consist principally in the smaller number of scales that compose the cone, their plain and flattened heads with inconspicuous ornament, and probably the shorter foliage. Like many fossil species, this cone is much more cylindrical or less conical than existing forms of the Pinaster section. I am unable to find any nearer living ally than *Pinus patula*, of Mexico, but this agrees with the fossil simply in the cylindrical and obtusely pointed form of the cone, and the almost unornamented scale-heads, but not in other respects.

No fossil at all resembling it has hitherto been described. It is relatively rare at Ballypalady.

Genus—Tsuga.

The genus was defined by Carrière to receive certain species of *Abies*, characterised by small cones with persistent scales, and flat, more or less two-rowed leaves. There are but five existing species, and these are confined to North America and Asia, the best known being perhaps *Tsuga Sieboldii*, of Japan, and the Indian Hemlock, and the Canadian and the Californian Hemlock-spruces. They are handsome trees, growing at considerable elevations and of large size, some reaching a height of 150 feet. No remains of them had been found in any rocks within the scope of this work until the past winter, when the specimens to be described were brought to light at Ballypalady in Antrim.

Tsuga Heerii, sp. nov. Plate XVI, figs. 1—4, and 10—16.

Pinus MacCluriI, *Heer* (pars). Flora foss. Arctica, vol. vii, p. 65, pl. lxxxvii, fig. 3, 1883; non *P. MacClurii*, Heer, ibid., vol. i, pl. figs. xx, 16—18, p. 134, 1868.

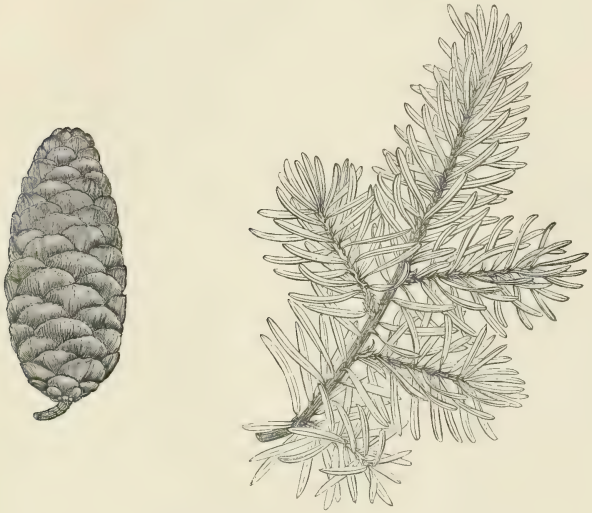
Basaltic Formation, Ballypalady, County Antrim.

The cones represented on Pl. XVI, figs. 1—4, though apparently dissimilar, agree somewhat in form and in the relative strength and position of the footstalk, and are all composed of thin, leathery scales. They may indeed belong to several species, but it is not wholly impossible for them all to have belonged to one, though perhaps shed at different stages of maturity. The scanty and imperfectly preserved material does not in any case afford data for separate specific determination, and it is therefore convenient to group them together. Fig. 1, Pl. XVI, is a cone sixty millimètres in length and twenty in diameter, seated on a short, stout footstalk, and composed of numerous loosely imbricated, thin, apparently leathery acales, pointed as in *P. monticola* (Woodcut, fig. 26), and striated and spoon-shaped to receive the seed. Fig. 2, Pl. XVI, is a slender, ovate, elongate cone, tapering to the extremities, thirty-five millimètres in length and fifteen millimètres in breadth, erect on a short, stout footstalk. The scales are imbricated, thin, leathery, about forty-eight in number, elliptical, with entire margin, seven millimètres across, but becoming very small towards the base, and irregularly but distinctly striated longitudinally. A similar though larger cone was described as *Elate austriaca*,[1] a genus founded by Endlicher on account of the wood-structure, which he considered to be nearer that of the *Larch* than of any other conifer. Fig. 3, Pl. XVI, is a closely imbricated cone, fifty millimètres in length and about fifteen in diameter, curved, very pointed, and seated on a stout footstalk. It is difficult to make out the form of the scales, as they are not separable in the specimen, but they are deeply striated longitudinally, and were possibly fringed. Fig. 4 of same Plate is more like fig. 1, and seems to have possessed broad, thin scales and large seed.

Fig. 1 might possibly be a *Pine* of the *Cembra* section, though I have not seen any species of such relatively small dimensions. Fig. 2 somewhat recalls *Tsuga jessoënsis*, and also the *Larch*, though its stem has not the external appearance so characteristic of that genus. The scales of fig. 3 might have been fimbriated, or the presence of bracts may have caused this appearance. On the whole, there is no genus they can be more satisfactorily placed in than *Tsuga*. Figs. 5—7, Pl. XVI, are referred to under *Pinus Plutonis* (p. 70), though their apparently leathery scales seem to ally them more especially with the cones above described. Casts of undoubted Pine are found in precisely the same state of fossilisation, and it is difficult to determine definitely whether

[1] Unger, 'Chloris Protogæa,' pl. xix, figs. 1—8, p. 70, from Niederwallsee, Lower Austria.

they are cones of *Fir* or of *Pine*. Figs. 10, 12 and 13 are acutely pointed acicular leaves, measuring respectively 20 × 2, 30 and 40 × 3 millimètres. The two former especially agree with the leaves of *Tsuga*, though the appearance of a double mid-rib seems to suggest *Sciadopitys*. Fig. 11 is a somewhat wider leaf, measuring 25 × 4 millimètres.



FIGS. 31 AND 32.—*Tsuga Pattoniana* (Veitch's 'Manual of the Coniferæ').

Fig. 16 is a small, elongate, narrow seed, with an ample, thinly membranous, pseudo-samaroid wing, twenty-six millimètres long and ten millimètres across at its greatest breadth, belonging apparently to some larger scaled cone than any of those figured. Figs. 14 and 15 are striated scales with entire margins, twenty-four millimètres in length by twelve in breadth. The seed is apparently of *Abies*, and the scales may be of the same genus, or possibly of *Pinus*.

Several cones, differing equally from each other, and with thin, leathery scales, have been figured by Heer in the "Flora fossilis Arctica," under the name of *Pinus* (*Abies*) *MacClurii*. The first were described from Banksland in 1868, and are small and cylindrical, with very numerous scales; the next was a small pointed cone with large scales and seeds from Netlvarsuk, in Greenland, published in 1874; and the third from Hare Island, identical with our Fig. 2, and published in 1883.

I have named my specimens provisionally after the late Professor Heer, with the reservation that, should it subsequently be found possible to define the thin scaled cones

more exactly, and to separate them specifically from each other, the name is to remain attached to the form shown in fig. 2 of Plate XVI.

The species belonging to the Cupressineæ, Taxineæ, and Taxeæ, to be described in the following pages, are somewhat out of their proper sequence,[1] but it appears more convenient to take them now while we are occupied with the Gymnospermæ, than to postpone their publication until that possibly indefinite future when all the Families of Plants shall have been disposed of in rotation, and the inevitable Supplement commenced. Various considerations, geological and palæontological, of both physical and theoretical nature, had led me to the belief that the determination of the newer Fossil Floras of Ireland and Scotland as Miocene rested upon no sufficient data, and that they might well be of such antiquity as to come within the scope of the present work. Visits to Dublin and Belfast convinced me that the existing collections were wholly insufficient for descriptive purposes; and, with the aid of a grant from the Royal Society, I have therefore set to work to obtain an adequate representation of these Floras. This work is still in progress, but the results so far comprise many hundred specimens, and the Coniferæ among these, supplemented by others obtained for the Belfast Museum, by that thorough botanist, Mr. S. A. Stewart, are now figured.

So little is generally known, even to those most interested in fossil plants, respecting the deposits of Ireland and Scotland from which those under consideration are derived, that it will enable us to understand them better and therefore invest them with a higher interest, if I briefly describe their chief geological features here, and the reasons which render it impossible, or at least inexpedient, to exclude these Floras from the present Monograph. The consideration of this question has the additional advantage of bringing home to us the imperfection of our knowledge on all subjects connected with fossil plants, and the futility of attempting as yet to infer from them the relative ages of rocks. It is encouraging, however, to believe that our present ignorance will sensibly lessen as this work progresses; for, as already pointed out, nowhere else in the known world is so vast a series of plant-remains intercalated among strata whose ages are absolutely known. It would indeed be singular, if some at least among them, when properly determined, do not take rank as landmarks side by side with fossils of the Animal kingdom.

In England we have not hitherto had to depend much upon plant-remains for our

[1] The publication of the present Monograph, while collecting is still in progress, is attended with considerable inconvenience, and its continuity is to a great extent destroyed. This is unavoidable, however, for it must be borne in mind that, as plants are imbedded piecemeal, we are often far from knowing as much of the organism even when many specimens have been obtained, as a single specimen would usually reveal among the Invertebrata. Years of collecting may yield nothing but detached leaves, fruits, or flowers, their connection being merely matter of inference, until some day the exact specimen required to convert inference into fact is unexpectedly discovered. Thus the collection of fossil plants can never be considered complete so long as the beds containing them are accessible, and their description and publication must either be undertaken with these inherent drawbacks or postponed to a time that would ever recede.

determination of the ages of strata, and their importance has thus come to be regarded in this country as trivial or at least subordinate. The fact, more and more apparent every day in other countries, and now brought home to us in Ireland and in Scotland, that the determination of the ages of strata of vast area and thickness sometimes rests entirely on the plants imbedded in them, must eventually, however, open our eyes to their importance, and those who contribute in any way to the advancement of their study will have the satisfaction of contrasting our present knowledge and estimation of them with what we may anticipate it to become when this work has reached its conclusion.

The Basaltic Formation of Ireland and Scotland.

The Basalts of Ireland have frequently formed the subject of communications to local and other scientific bodies. Their authors have, however, been uniformly satisfied to accept the current opinions as to their age, based upon the scanty and imperfectly understood plants found in them; and none of the descriptions are of an entirely comprehensive or exhaustive character. The Scottish Basalts have been more broadly treated of by Professors Geikie and Judd; but, as with those of Ireland, no clue to their precise age exists, except their plant remains. The only locality hitherto known to yield them in a satisfactory condition is Ardtun Head, in Mull; but a locality in the Isle of Canna has been discovered which may supplement the former Flora. The leaf-bed here forms the roof of a small cave, and the specimens obtained have become very friable from exposure to weather. I think it will be better to defer the description of the Scotch Basalts until I have been able to visit personally and collect from the new locality.

The Basalts of Ireland extend over an area that is roughly estimated at 1200 square miles, comprising nearly the whole of Antrim and portions of the adjoining counties of Londonderry and Tyrone. They form an elevated plateau bounded for the most part by noble escarpments with precipitous flanks, rising to elevations of 1000 and 1500 feet. Their total thickness is but 1100 feet, though these igneous rocks are estimated to reach in Mull not less than 3000 or 4000 feet.

These Basalts are but a small fragment, the mere southern limit, of a series of stupendous outpours of lava that once extended probably in an unbroken mass northward through Scotland and the Faröes to Iceland, where they are of unknown thickness. Nor would this represent their extreme limits, as may be seen in Scotland, where innumerable dykes diverge from them and penetrate through England to the North Sea. Their northern extension is as yet unknown, and their boundaries may probably have to be traced in Greenland and even Spitzbergen. Vast as this area is, it is not wholly without parallel elsewhere. A region in the Deccan, 200,000 square miles in extent, has been converted into a plateau of horizontal sheets of Basalt whose aggregate thickness is 6000 feet. These Indian flows are of Cretaceous age, and therefore preceded ours; but in

Oregon another enormous tract, estimated to equal the whole united areas of France and England, has been overwhelmed, and become an undulating plain of Basalt at so recent a date that it has been thought likely that the latest flows may have taken place within the human period. All these are believed to have welled up from great fissures, for no conceivable number of cones or craters would be adequate to produce such vast, level, and continuous sheets. They are termed "massive eruptions," and "represent the grand fundamental character of vulcanism, modern volcanic cones being regarded as merely parasitic excrescences on the subterranean lava reservoirs, very much in the relation of minor cinder cones to their parent volcanoes."[1] The distinguishing feature of lavas erupted in this way is their horizontal bedding and the rarity and massive size of the intersecting dykes, contrasted with those which are found diverging in all directions from true craters that have been denuded of ash.

The Basalts of Ireland were not erupted at one period, but have been grouped by Prof. Hull into three classes, the oldest of which includes highly silicated felspathic trachytes, porphyry, pearlstone, and pitchstone. The second comprises beds of basic amygdaloid, with bands of bole, volcanic ash, &c. The third is formed of massive sheets of columnar Basalt. A long interval, marked by the changed characters of the lavas, is supposed to have intervened between these stages. Be this as it may, considerable intervals of time are indicated by the boles, lithomarges, and lignites, which must each mark at least an interval sufficiently long for a considerable depth of the compact Basalt to have decomposed into vegetable mould, and remained, perhaps for ages, a soil on which a luxuriant vegetation flourished; while the lignites and even true coals, six or seven feet thick, found in them, must mark still greater intervals. The eruptions of Basalt were succeeded, at least in Scotland and Iceland, by trachytic flows, which seem to have ended the great period of volcanic energy to which the plants under notice belong.[2]

The enormous period required to build up masses many thousand feet thick, and stretching over 1000 miles in a direct line, may not unreasonably be supposed to represent an entire geological epoch; but a yet vaster time must have been required to sculpture the once continuous sheets into their present contours. This has not been effected to any appreciable extent by upheavals or dislocations; but the mountains have been carved out of the solid, inch by inch, by the slow process of weathering, which has cut down through them to a depth of over 2000 feet. River-valleys had been weathered out of them, according to Geikie, before the trachytes of the Scur of Eigg were erupted. The plateau-like aspect, still maintained in the Basaltic area of Ireland, has been lost in Iceland, where denudation has cut them into long rolling hills, separated by wide and nearly parallel valleys. The denudation is colossal, and solitary pinnacles or protuberances everywhere attest, like monuments, the former presence of Basalts, of which

[1] Geikie, 'Text-Book of Geology,' 1882, p. 256.

[2] The present localised manifestations in Iceland are as utterly disconnected from the Tertiary Basaltic outpours as an outbreak in Ireland to-morrow would be.

no other trace remains. The Faröes are even more eloquent of waste. This little group of some twenty islands and islets presents the ruins of a once continuous plateau, 2000 or more feet in height. The hills, as in Iceland, are usually flat-topped, but the cliffs, frequently 1000 and sometimes 2000 feet high, are almost vertical, and are fretted, especially on their western faces, into weird and fantastic forms. The sub-aërial waste is here supplemented by the attacks of the waves, and the sea for miles round is shallowed by the redeposited silt.

"Some of the noblest hills of the Inner Hebrides are but solitary outliers left standing amid the ruin of the great sheets of solid rock of which they once formed a part. Ben More, in Mull, though more than 3000 feet high, is only a magnificent fragment of the huge pile of volcanic material which formerly swept over what are now the deep glens and fjords of Mull. The long lines of imposing cliff with which the basalt plateaux front the Atlantic all through these islands, from the Fair Head of Antrim to the far headlands of Skye, tell everywhere the same tale of vast and continuous denudation."[1] "But most strikingly of all is this fact of enormous denudation of the Scottish Highlands during very recent geological periods, demonstrated by the occurrence of post-Miocene faults, having downthrows of various amounts up to nearly 2000 feet, the effect of which upon the surface has been entirely masked by post-Miocene denudation."[2] When we reflect that even this colossal denudation may be insignificant to that effected over tracts which are now sea, or to that which has acted over land-surfaces which no longer present any shreds of Basalts, except the dykes through which they welled, we feel compelled to stretch back our conception of the time during which the causes may have operated to the uttermost possible limits.

These limits cannot go beyond the White Chalk, for the lavas rest upon its denuded surface or upon the capping of angular flints and loam, which denote its former exposure to atmospheric influence. In Scotland, moreover, according to Judd, the Upper Chalk is covered by intervening estuarine and coal-bearing strata, sufficing to negative the idea that the Basalts were in any way contemporaneous with the Cretaceous series as developed in Great Britain. There is no physical evidence, however, against their belonging to any part of that vast period which intervened between the British White Chalk and the British Eocenes, nor to any stage of the Eocenes; but they do present evidence of such great antiquity that we ought to hesitate to assign them to any later period unless very good reasons for doing so were apparent.

The plant evidence upon which they were classed as Miocene has always been of the weakest description; and, had any of the geologists who have written about them troubled to look into it independently, the conclusion as to their age would never have been accepted. It was somehow assumed that the Antrim plants were on the same horizon as the Mull plants, and that since the latter were said to be Miocene the former

[1] Geikie, 'Quart. Journ. Geol. Soc.,' vol. xxvii, p. 285.

[2] Judd, ibid., vol. xxxiv, p. 669.

must necessarily also be of that age. When, however, the Mull plants were described by Edward Forbes in 1851 [1] no more could be said about them than that they might belong to Taxites ?, Filicites ?, Rhamnites ?, Platanites ?, Alnites ?, and that "the general assemblage of leaves, when judged by the present [1851] state of our knowledge of the vegetation of ancient epochs, is decidedly Tertiary, and most probably of that stage of Tertiary termed Miocene." Heer was subsequently unable to definitely claim more than one, and that perhaps the least satisfactory of all, the Taxites,[2] as a Miocene form. We now know that the plants bear at least as strong a resemblance to those of the Cretaceous beds of Dakota as they do to those of any European Miocenes, and much might be said in support of their reference to a late Cretaceous age. But to whatever age it might be possible to assign the Mull Flora, the age of the Antrim Floras would still be a matter of question, for they have nothing in common, except perhaps a Conifer described now for the first time from Mull, and which could not have been taken into account in former comparisons of the Floras. They both, however, bear no small resemblance to certain of the Tertiary Floras of Greenland, whose age I have already demonstrated to be no less open to question.[3] Not only has our knowledge of Cretaceous and Cretaceo-Eocene Floras enormously expanded since their ages were first defined, but we are also gradually becoming aware that the Eocene Floras were far more changing and varied than had been supposed. We no longer believe that all Floras comprising modern and temperate-looking genera, such as the Plane, Hazel, Beech, Alder, Poplar, Willow, Elm, Liquid-ambar, Sassafras, Pine, Redwood, and Swamp Cypress must be Miocene, nor that Floras containing Palms, Proteaceæ, Figs, Aralias, Podocarps, and Araucarias, are the only ones distinctive of the Eocenes.

The time has not yet arrived for entering more deeply into a question which can only be fully discussed when all the plants have been determined; and it would be useless to attempt now either to point out the actual evidence connecting the plants of the Basalts with the Eocene period, or to dwell upon the absolute insufficiency or rather total absence of evidence connecting them with the Miocene. I will now terminate this digression, rendered necessary at this stage of the work by the progress of our researches and the new series of plants that have in consequence to be incorporated, by a brief description of the actual localities whence they are being obtained. They are so far entirely confined in Ireland to the middle zone of the Basalts. The amygdaloids of which this is largely composed are closely similar to those of the Faröes and Iceland, and are probably of the same age. The plants are already known to occur in white clay, in lignite, in clay-iron-ore, nodular iron, and as silicified wood, at several places; and it is generally conceded that the three former varieties of matrix are on or about the same horizon, estimated at some 600 feet from the base and 400 feet from the top of the formation.

Irish bauxite, or hydrate of alumina, is a nearly white aluminous earth which

[1] 'Quart. Journ. Geol. Soc.,' vol. vii, p. 103.

[2] *Sequoia Langsdorfii*, according to Heer.

[3] See before, p. 3.

adheres to the tongue when dry, and never becomes plastic when wet. It is quarried near Glenarm, and certain beds a little in rear of that town, formerly cut through to reach it, abounded in handsomely preserved plant remains, whose dark colour rendered them conspicuous against their white matrix. It is unfortunate that during the whole progress of the quarrying operations no one, not even the officers of the Geological Survey, who were then on the spot, thought it worth while to collect, so that only a few stray specimens were preserved. I am able, however, through the courtesy of their proprietor and the energy and interest taken in the subject by Mr. Walter Jamieson, to have the mine drained and again rendered accessible, so that I have great hopes that this, by far the most beautiful and best preserved of any Flora included in the Basalts, either of Greenland or elsewhere, may be properly investigated. It seems to be similar to the Ballypalady Flora except that it is far richer in leafy trees. A detailed description will not be possible until the drainage of the mine shall have been accomplished.

The principal deposits of lignite are above the bauxites and sometimes rest upon them. The thickest beds vary from two to five feet in depth and occur at Ballintoy on the coast, about thirty miles distant from Glenarm. They are full of compressed wood, with well-defined structure and belonging to trunks of trees which must in some cases have been of considerable girth. The leaf-bearing portions are very compact, but split readily into laminæ, on the surfaces of which the leaves, fragmentary and much macerated before being imbedded, are faintly defined by their more glistening surfaces. The majority of the leaves contained in them belong to a peculiar triple-nerved form, whose affinities are not yet understood, named *MacClintockia* by Heer, and which is abundant in some of the Greenland shales.[1]

The Iron-ores are widely spread, and occasional minor beds of bole are distributed throughout the formation without any apparent order; but these are merely the result of the surface decomposition of the lava between successive flows. The principal beds are on one horizon, and extend from the coast near the Giant's Causeway to Ballypalady, a spot a few miles south of Ballymena. Opinions differ as to whether the pisolitic ores were formed by confervoid Algæ in shallow lakes, or are the more direct products of the decomposition of Basalt. All the boles that were formerly sub-aërial soils are unfossiliferous unless roots or stems happen to be preserved, which is often the case, while the pisolitic ores and conglomerates, if really lake-deposits, have probably from their nature permitted the plants they may once have contained to go on decaying away after they were embedded. The only fossiliferous iron-ores occur at Ballypalady, about a mile from Templepatrick, and were formerly quarried on each side of the railway. Detailed sections have been published by Portlock, Tate and Holden, Baily, and Kinahan, but the changing operations of the quarryman have made it difficult to exactly reconcile them with the faces now exposed. The beds are laminated clay-iron-ore, fine breccias or conglomerates, and thin seams of lignite irregularly deposited and somewhat twisted, and some twenty-five feet

[1] The best account of the Irish Lignites is that by Mr. William Gray, 'Tenth Annual Report of the Belfast Field Club,' 1872–73, p. 28.

in total thickness, though it is not apparent that their base is exposed. The quarry runs east and west for nearly 200 yards, the direction having been determined by a dyke which forms for some distance its northern face. Plants occur throughout the finer kinds of sediment, though fir-cones sometimes extend to the coarser matrices and are generally more abundant towards the base. They have hitherto been supposed to be lacustrine, but the coarseness and brecciated nature of some of the layers and their irregular bedding seem to indicate, on the contrary, deposition by running and shifting water of very variable volume. The presence of fir-cones and other fruits, associated together with objects, such as Pine-needles and leaves, of such very differing specific gravities, does not, on the other hand, accord with what is usually observed in assemblages of plant remains deposited by moving water. Perhaps the true explanation must be sought in a series of backwaters or isolated pools of sluggish or stagnant water liable to sudden floods or great accessions of volume. They are certainly neither lacustrine nor swamp deposits.

There is still considerable doubt as to the true matrix of the celebrated silicified wood of Lough Neagh, but this is a question with which we are not here materially concerned. The iron-stones with leaf-impressions, which are found on the shores of the same lough, are of more immediate interest, and it would be of some importance to ascertain their real age. I believe them to be *in sitû* in the extensive so-called Pliocene deposits of blue clays and surturbrands, which are stated to occupy an area ten miles in length by four miles in breadth, and to have been bored to a depth of 300 feet without bottom.[1] The leaves seem to differ from those of the other localities, and to be nearer those of existing Beeches, Alders, and Willows. The nodules appear in every way identical with those met with on the Norfolk coast near Bacton at certain states of the tide. On the other hand, the resemblance they bear to nodules brought by Mr. Whymper from Greenland, of much older dates, is no less remarkable. The supposed Pliocene deposits seem to be younger than the period of volcanic activity, as they are quite free from scoriæ and ash, and independent of the Basalts. Their true age, however, is an interesting problem which the plant remains will undoubtedly enable us to solve.

Cupressus[2] Pritchardi, *Goepp.*, sp. Plate XVI, figs. 8 and 9; Plate XVIII, fig. 1, cones only; Plate XIX.

Pinites Pritchardi, *Goeppert.* Foss. Conif., p. 220, 1850.
Cupressites MacHenrii, *Baily.* Quart. Journ. Geol. Soc., vol. xxv, p. 357, pl. xv, fig. 5, 1869.
Cupressoxylon Pritchardi, *Krauss* in *Schimper.* Pal. Vég., vol. ii, p. 376, 1870-72.

Basaltic formation, Ballypalady, County Antrim.

The leaves are very small and scale-like, oval-pointed, imbricated in four rows, either

[1] 'Brit. Assoc. Report.,' 1853, Griffith, p. 43.

[2] See *ante*, p. 25.

two or three of which are visible according to the position in which the branchlet has been embedded, or with the points slightly spreading and falcate.

The foliage is adequately represented by two or three exceptionally fine specimens, and innumerable smaller branchlets. The largest measures seven inches in length, and the principal stem is clothed with relatively long, adpressed, decurrent, scale-like leaves, with points free and acute. The lateral branchlets are much subdivided, branching at angles of about 45°; the ultimate shoots are alternate, rarely exceeding twenty millimètres in length, and have the appearance of very finely plaited cord. The branchlets seem usually to have been shed in segments of about the size represented (Pl. XIX, fig. 4), Figs. 1, 2 (Pl. XIX) being exceptional. The cones are globular or slightly oblong, about fourteen millimètres long and composed of ten hexagonal scales. The scales quit the axis at nearly right angles, are irregular in size and form, with the head having unequal sides and ornamented with wrinkles converging to a nearly central boss or prominence elongated transversely to the axis. Two scales are sometimes soldered together, but the basal ones are not united as in the Bournemouth *C. taxiformis*. The cones occur singly or in clusters, sometimes of six or seven, and are seated on short footstalks five or six millimètres in length, to which they always remain attached. I have not hitherto found a cone attached to a leafy branchlet, but the footstalk is often clothed with scale-like leaves, sufficing to show that the cones and foliage really belong to the same species. The seeds have not yet been observed, owing no doubt to the unfavorable nature of the matrix.

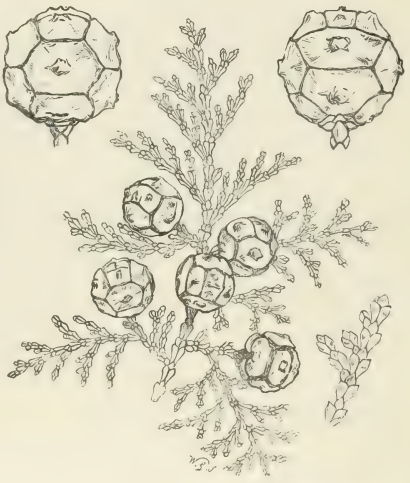


Fig. 33.—*Cupressus obtusa*. (Veitch's 'Manual of the Coniferæ.')

The cones and foliage united, present all the characters of a true Cypress. The foliation of many living species is very similar, but ours agrees in its most minute characters with that of *Cupressus funebris*, an Oriental variety of *C. sempervirens*, and *C. torulosa*. The presence of cones enable us to unite it more definitely with the latter, and to say that the Antrim species was, if not absolutely identical with the magnificent *C. torulosa*, so near it that it would, if living, not be separated specifically or even made a variety, so far as fruit and foliage go. The cones in the living species, as in the fossil, occur in great abundance, either solitary or in clusters, and detach themselves when ripe from the foliage and fall singly, or more rarely, two or more on a stem. The identity of

both these principal organs with those in a living form make it pretty well a matter of certainty that the other organs were also identical, and that the fossil formed a no less majestic tree than the living. If such an induction were not permissible, there would be an end to palæontology. We may, therefore, consider that our fossil Cypress was a tree, stately and erect, towering as straight as an arrow to perhaps a height of 150, and with a girth of a dozen or even a score of feet. We may picture a conical outline such as these trees now possess in their Himalayan habitats, with branches slightly drooping, the branchlets ferny and feathery and of a beautiful greyish green. The Cupressineous wood of Lough Neagh doubtless belonged to this tree, and huge logs of it were formerly found; and we may infer that before petrifaction it must have been as deliciously fragrant as that of *Cupressus torulosa*, held sacred by some tribes through its perfume. This does not prevent the clumps or larger masses which clothe the hills from 4000 to 8000 feet up, from suffering the same fate as the Deodar, where water-transit is available, and large quantities annually reach the Indian markets. A peculiarity about the Irish distribution of *C. Pritchardi* is that it seems confined to the Iron-ores of Ballypaladay, and is absent (unlike *Cryptomeria Sternbergii*) from the bauxites and lignites and from the shales of Mull, telling eloquently that the former was formed nearest the mountain habitats it loved. Its preponderance shows how largely the old Alpine forests of Antrim were composed of it. Mr. Baily's figure conveys an inaccurate idea of the foliage, the leaflets being made to appear subangular instead of oval-acute; and no sufficient specific diagnosis is attached to it. I have restored Goeppert's original name to this splendid and truly representative species from the Irish Tertiaries, since no inconvenience can arise through including the wood with the other organs under the same specific name.[1]

If present elsewhere in Europe, it has been mistaken for *Juniperus* or *Glyptostrobus*; but I am of opinion that Antrim was its southern limit, at least during the Middle and Upper Eocenes. It seems to have been present in some of the more northern Floras, though no satisfactory figures of it occur in Heer's works. Any of the very unsatisfactory fragments figured as *Thuites Ehrenswärdi*, *Th. Meriani*, *Th. Parryanus*, might have been detached from the specimens represented in figures 1 and 2 of Pl. XIX, and Mr. Whymper's Greenland Conifer, determined as *Widdringtonia helvetica*, may probably also belong to it.

Genus—Cryptomeria.[2]

This genus is confined to China and Japan, and now possesses only one species, though many varieties have been produced during the ages it has been under cultivation. The male and female flowers are separate but on the same plant. The cones are solitary or

[1] A careful examination, by Mr. Carruthers, of some twenty prepared sections of different specimens of the wood from Lough Neagh failed to show any variation or new characters, all apparently belonging to one kind of tree.

[2] See *ante* p. 29.

two or three together, without foot-stalks, spherical and terminal, with loose scales fringed at the edges. There are from three to five seeds under each scale, with slight membranous wings. The leaves are in five rows, irregularly four-sided, sickle-shaped, acutely pointed, decurrent, and persistent. The tree is large and evergreen.

CRYPTOMERIA STERNBERGII, *Goeppert*, sp. Plate X, figs. 2, 3, 10—13; Plates XX and XXI.

ARAUCARITES STERNBERGII, *Goeppert* (pars). Ettingshausen, Die Eocäne-Flora des Monte Promina, p. 12, pl. v, 1855.

SEQUOIA STERNBERGI, *Heer*. Flora foss. Arctica, vol. iii, part 3, pl. ii, figs. 1—4, p. 10, 1874, &c.

— DU-NOYERI, *Baily*. Quart. Journ. Geol. Soc., vol. xxv, p. 361, pl. xv, fig. 4, 1869.

Basaltic Formation, Ballypalady and Glenarm, County Antrim; and the Isles of Mull and Canna.

The leaves are spirally arranged, crowded, four to seven millimètres in length, decurrent, and somewhat expanded at the base, quitting the stem at an angle of about 40°, falcate or faintly spathulate, tapering to the extremity, very variable, sometimes apparently imbricate, more often needle-like.[1] The branchlets, densely clothed with leaves, are irregular or alternate, fork copiously at acute angles, presenting a somewhat tufted growth, and were shed in short lengths separately from the cones. The cones sub-globose, and averaging from fifteen to twenty millimètres in diameter, are composed of numerous persistent, loose, apparently sub-ligneous scales, which all diverge from a point near the base of the cone and are clothed externally with spiny, bract-like appendages.

The cones were shed after the escape of the seed, with the scales gaping and permitting the matrix to enter between them. When found they almost invariably split down the centre, leaving half on each face of the stone so as to present a longitudinal section (Pl. XX, figs. 8, 9, 13). Only the inner faces of the scales are thus exposed, and these are seen to be striated, with roughly-fringed edges. When the impression of the exterior of the cone has been bared with a needle, six or eight spirally-arranged scales become visible. These are seen to be quite constricted at the base, then gradually widening until they fan out suddenly to a diameter of six or seven millimètres, after which they again contract so as to terminate in the form of a slightly-pointed arch. They are crossed exteriorly at the widest part by a deep but narrow scar, in the centre of which is a pit marking the position of a central spine or bract which has projected into the matrix at right angles. The entire scale is grooved or furrowed parallel to its lateral margins, and deeply cut or fringed along the superior one, the segments of this fringe being often slightly subdivided.

[1] The leaves appear shorter and blunter when pressed against the stem than in profile, owing to the extremities breaking away with the matrix.

The axis does not penetrate the cone, and all the scales are directed upward and diverge at acute angles from a single point, but it is prolonged inferiorly into a sort of footstalk, which occasionally seems obscurely scarred.

In no specimen known to me from Ballypalady, out of nearly 100, are cones attached to the foliage, though they are always found in singular proximity (Pl. XX, figs. 3, 4, 6, 8, 13). The cones bear a strong resemblance to those of *Thuya*, and, if they could be united to the imbricated Cypress foliage, such species as *Th. gigantea* and *Th. orientalis* would be apparently reproduced. But if such were the case, the Cypress foliage would have to do duty for two sets of cones belonging to different genera, while the lax foliage would have to be assigned to some Conifer with fruit so inconspicuous as to have escaped notice, such as some of the *Dacrydia* or *Juniper recurva*. The cones, however, are composed of many more scales than are met with in *Thuya*, and for many reasons I think we may dismiss such a determination and accept the view that the cones and foliage described are actually the product of the same plant. In this case their reference to *Thuya* becomes impossible, for though a few *Thuyæ* and *Cupressi* occasionally bear a lax foliage, it is either of different type or confined to the seedling stage of growth.[1] Our choice is in fact practically narrowed to *Cryptomeria*.[2]

Fig. 34.—*Cryptomeria japonica* (Veitch's 'Manual of the Coniferæ').

In comparing our cones with those of the existing *Cryptomeria* several important differences are observable. The base of the cone is much broader in the living species, the form more pyramidal, the basal scales directed downwards, and the fringed margin more regular and deeply indented. On roasting some of the cones in plaster, so as to reproduce to some extent the condition of the fossils, the resemblance is greatly increased, for the umbonal spine leaves a similarly cleanly-cut transverse scar in nearly the same position across the scale, which is also seen to be similarly furrowed and of the same outline, except that the scar in the fossil is a little lower down. The foliage is shorter and denser, and inclined in places to become more imbricated than in *C. japonica*.

The divergence between the fossil and its living representative is more accentuated

[1] *Th. occidentalis, Cupressus nutkaensis, C. funebris, C. fastigiata, Widdringtonia cupressoides,* and *W. juniperoides,* occasionally bear foliage of both kinds.

[2] Since the above was in type, foliage *with cones attached* from Glenarm have amply confirmed the determination.

than is usually the case with the Coniferæ of so late an age as the Eocene. The reason of this exceptional differentiation may be looked for, it appears to me, in the fact that the single existing species of *Cryptomeria* has been cultivated unremittingly in Japan, perhaps for many centuries, with a view to produce sports and varieties, which were held in religious esteem. One well-known variety in cultivation, *C. elegans*, has foliage which departs widely from the original type, while another, *C. araucaroides*, approaches the fossil closely. The *Cryptomeria* of our gardens is a variety introduced by Mr. Fortune from seed gathered in the north of China and the Isle of Chousan, and has leaves nearly twice as long and more closely pressed to the branches than the true stock of Japan. Plants transplanted to hills in Java, under similar conditions of soil and temperature, have rapidly degenerated, and approach the fossil type of foliage. The excessive fimbriation or bractation, which masks the structure of the cones, has probably been increased by artificial means, for apparently starved cones in England much more nearly approach the fossil, and the frequent tendency of the axes to penetrate through them and to foliate is additional evidence that they have become somewhat abnormal under cultivation. All the genera of the Taxodieæ have been met with in some abundance in Cretaceous and Tertiary rocks except *Cryptomeria*, and it does not seem unreasonable to suppose that the changes brought about by ages of cultivation have rendered its recognition difficult.

There can thus be little doubt that our Conifer is the wild stock of the considerably-modified *Cryptomeria* of Japan, and that this then bore a greater resemblance to the nearly-allied *Taxodium heterophyllum* than it does at present. It still loves a basaltic and humid soil, and under such conditions forms vast forests; at least a tenth part of those which clothe the three principal isles of Japan, from 500 to 1200 feet above the sea, being formed of this tree. Its fine pyramidal crests and deep green contrast with the Laurels and Bamboos, and give a peculiar and characteristic aspect to the wooded regions of Eastern and Southern Japan. In more western and northern latitudes, where leafy evergreens are rarer, it combines with the Abietineæ and Cupressineæ and evergreen Oaks to impart a freshness to the forest vegetation during winter.[1] It reaches a height of 130 feet, and occasionally rivals its companion Cypress in girth, and is a majestic and graceful tree, strongly recalling *Araucaria Cunninghami*.

The fruits of this species exceed in abundance those of the associated *Cupressus*, and indeed all other fossils at Ballypalady. Unlike the Cypress, it abounds under the bauxite, as we might expect on the supposition that these contain the spoils of lower land, for it now ranges to within 500 feet of the sea-level, while the Cypress is a more purely Alpine tree. It, or something like it, has also been found in Mull and Canna, and seems everywhere present among the Arctic Floras described by Heer, though referred to the genus *Sequoia* in his works. I have little hesitation in also referring the so-called *Sequoia Sternbergii* of Monte Promina to it, as I have specimens of foliage which are not only

[1] Siebold, 'Flora Japonica,' 1835.

identical, but associated with the scale of a similar cone; and it may therefore possibly have had a considerable range in Europe. The foliage and cones are easily distinguishable from any others in the British Tertiaries.

The variety recently obtained from Glenarm approaches far more closely to the ordinary and more luxuriant type at present existing in Japan.[1]

The iron-ore or bauxite mine of Libbert, whence they were obtained, is situated at about 700 feet above the sea-level and nearly a mile in rear of Glenarm. No outcrop of the strata is visible in its vicinity, except an occasional patch of basalt on the roadside; but its position must be some 400 or 500 feet above the junction with the Chalk, and therefore probably at about the same horizon as the plant-bed at Ballypalady. The shaft or adit is horizontal, and the work of draining it, though long and laborious, was not one of serious difficulty. For the first 20 or 30 feet it pierces Boulder-clay, and about a dozen feet farther in, a compact, almost white, sandy clay is reached, in which the plant remains occur. The base of the adit is almost indurated micaceous sand of unknown thickness, said by the miners to repose on lithomarge. As the beds rise slightly with the slope of the hill, the rest of their thickness can be studied as they are successively cut through. The "leaf-bed" is more compact and clayey, and for about a foot in thickness contains well-preserved plant impressions. It passes upward into imperfectly laminated clayey sand, stained grey with vegetable matter, and enclosing limbs and trunks of trees. The "leaf-bed" seems to be confined to an area of not more than two square yards, but the darker clayey sand extends far into the mine, and contains less distinct impressions at those points where it has been examined. Overlying this is a singular conglomerate made up of rounded pebbles of reddish indurated clay embedded in a hard gritty paste. The surfaces of these pebbles are polished and darkened by squeezing and pressure, and it is difficult to realise at first that some of them are not flints. There are also coarse quartz grits cemented together by a clayey matrix. The bauxite, a ferruginous hydrate of alumina, overlies these, and is said to be about 30 feet above the "leaf-bed," and also contains masses of lignite and trunks of trees. Deeper in the mine it becomes blotched with red and gradually passes into the iron-ore, by which it also is overlain. The deposit, like those of Ballypalady and Ardtun Head, is fluviatile, and marks the former bed of a river.

The leaf-bed, though rich in specimens is poor in species. There are but two prevailing varieties of leafy trees, the commonest being a large and deeply indented leaf, such as might be borne by a large-leaved oak or maple; and the other a long parallel-

[1] When the descriptions of the Coniferæ were first undertaken, none of the materials for the plates illustrating the Basaltic Flora of Ireland had been brought to light. The method of publication in yearly parts permits revision and addition while the work is in progress, and the latest interval has been utilised in repeated visits to Antrim, during which the Ballypalady specimens, occupying plates xv—xx, were obtained and figured. A further slight delay has also enabled me to insert an account of the fine specimens just obtained from Glenarm. The plant-beds had been deep under water at the time of my former visits.

veined leaf, known as *MacClintockia*, belonging to a shrub perhaps which might have formed an evergreen undergrowth. With these, and lying in every direction, are tufts of *Cryptomeria*.

I ventured previously to assign the disjointed fragments of foliage and the small cones so abundant at Ballypalady to this genus, although I had not seen them actually attached together. Here we have, however, at Glenarm, branchlets of most luxuriant growth, with cones actually seated upon them (Pl. XXI), and possessing every characteristic of *Cryptomeria*.

The leaflets are larger and more crowded than those of Ballypalady, but not quite so large as in the existing species, woodcut, fig. 34. The branches were so densely tufted that their branchlets are compressed four or five deep upon each other, and they present the peculiar parallelism and acute angles of divergence of the existing species. The foliage is smaller than that of *Araucaria Goepperti*, Pl. XI, fig. 1, and does not present any trace of seasonal variation. The cones are globular, usually solitary, but sometimes two are attached to the same branchlet, which is thickened to support them. They are rather less than an inch in diameter, composed of numerous fringed scales springing from a short axis, and seemingly identical in structure with living examples. The tree must in fact have been similar in appearance and habit to the most luxuriant of the existing types; and it is quite apparent from this, no less than from its great abundance, that the station it occupied was a highly favorable one.

It might be questioned whether it should remain united specifically with the relatively starved variety of Ballypalady, but the fact that the living species varies in at least an equal degree, according to the nature of its station, seems to preclude any separation. It does not appear that any other Conifers accompany it in the beds at Glenarm.

Genus—Taxus.[1]

Taxus Swanstoni, sp. nov. Plate X, figs. 4, *a* and *b*, and 5.

Basaltic Formation, Ballypalady, County Antrim.

Only simple branchlets of this rare fossil have hitherto been met with. The best specimen measures seventy-five millimètres in length, but its base appears rather broken than articulated. It is clothed only for the first half of its length with short, very obtusely pointed, undeveloped, spirally disposed, scale-like leaves, some of which become expanded higher up into distichous leaflets of a yew-like aspect. These are narrow, linear, variable in size up to fourteen millimètres in length, opposite or alternate, parallel-sided, obtusely pointed, shortly decurrent, and with distinct mid-rib. A few seem adpressed to the stem, but the great majority quit it at almost a right angle. The terminal leaflets are very small, and the apex of the branch is consequently somewhat truncated.

[1] See *ante*, p. 43.

The short and obtusely pointed undeveloped leaflets, and the obtuse angles formed by those which are expanded, and their blunted apices, serve to distinguish it from other British species, and especially from that described as *Sequoia Langsdorfii* from Mull. These characters agree much more closely with those of the Yew than with any other Conifer, and particularly with some forms of *Taxus cuspidata* of Japan in the Kew Herbarium, and *T. baccata Maderensis* of the Canaries. *T. cuspidata* is a hardy species found on the Island of Jezo, and the Madeira Yew is almost extinct.

I have named the fossil in compliment to my friend Mr. William Swanston, F.G.S., and Hon. Secretary of the Belfast Naturalists' Field Club, to whom I am indebted for much kindness and assistance.

Some of the Arctic specimens determined as *Sequoia Langsdorfii*, *Taxites validus*, and *T. Olriki*, greatly resemble it, and an actual comparison may prove their identity.

ATHROTAXIS COUTTSIÆ, *Heer*, sp. (See page 36.) Plate VI, figs. 1—9; Plate X, figs. 6—9.

SEQUOIA COUTTSIÆ, *Heer* (pars: Hempstead). Quart. Journ. Geol. Soc., vol. xviii, p. 369, pl. xviii, 1862.

The cones are woody, globular, about thirteen millimètres in diameter, persistent after shedding seed, and composed of about twenty-four imbricated scales, arranged spirally on a very short axis. The scales are persistent, wedge-shape, contracted and stipitate at base, thickened at the apex; the heads are lozenge-shaped to pentagonal, wider, seven millimètres, than high, five millimètres, convex exteriorly, much hollowed interiorly to receive the seeds, with a more or less lozenge-shaped scar in centre. The scales become much smaller towards the base. Seeds of the same species are figured by Heer from Hempstead, and are small, curved, and winged laterally. The leaves are very small, thick in texture, closely adpressed to the branches, imbricated, spirally arranged, ovate, pointed, sometimes falcate, obscurely keeled on the back, concave on the face, entirely adherent at the base.

The discovery late last autumn of very perfect and uncompressed specimens of this Conifer at Hordwell revealed the fact that the scales of the cone are overlapping or imbricate as in *Athrotaxis*, and not at right angles to the axis as in *Sequoia*. In describing *Sequoia Couttsiæ* in the present work (*ante*, p. 38) I felt the unsatisfactory nature of the determination, remarking that the remains existing did "not conclusively establish the accuracy of its reference to *Sequoia*," and that the evidently swampy station it flourished in was at variance with the habits of either existing species. The leaves also are far more slender and delicate than those of the existing *S. gigantea*, and do not suggest that they could have belonged to a tree of robust habit and colossal size. I have no hesitation whatever in uniting the Hempstead specimens with this species, but those from Bovey-Tracey described by Heer have disappeared, and the figures give no

indication of the position of the scales on the axis, and their formation seems somewhat different. I do not therefore at present feel that the material would justify the transfer of the Bovey specimens to another genus, especially as their reference to *Sequoia* has been very widely accepted in text-books, and the supposed presence of a representative of the giant trees of California made the basis of much speculation and inference. I think it highly probable, however, that the species may be found not to be a true *Sequoia*, and the danger is very apparent of giving the reins to the imagination and picturing the slopes round the ancient Bovey water as clothed with woods composed "mainly of a huge coniferous tree (*Sequoia Couttsiæ*), whose figure resembled in all probability its highly admired cousin, the *Sequoia* (*Wellingtonia*) *gigantea*, Lindl., of California."[1] If the supposed *Wellingtonia* should prove to be but a marsh-loving plant, as the supposed tree-ferns of "imposing grandeur" have proved to be but humble Osmundas, how completely at variance must the actual appearance of the vegetation have been to that so graphically described in Heer and Pengelly's work.

The Hordwell specimens are indistinguishable from *Athrotaxis cupressoides* of Tasmania, "a small erect tree, from twenty to thirty feet high, much branched, and with numerous branchlets, which are slender, spreading or pendulous, and cylindrical."[2] "It is found at Lake St. Claire and along Pine River, in Tasmania, and is tolerably hardy." The *Athrotaxides* form a small genus, allied to *Sequoia*, now entirely confined to Tasmania. The fact that the species are little known and are still rare in herbaria has no doubt prevented hitherto the reference of any fossils to the genus. The occurrence of two undoubted and almost unaltered species in our Eocene is not a little singular, and of great significance.

Incertæ Sedis.

Two other Coniferæ, at least, are known to me from British Eocenes, but both too imperfectly to even guess the genera to which they might belong. They are both from the Lower Eocene, respecting whose Floras our knowledge is so scanty, that it would be of great interest to ascertain more concerning them. The first is from Reading, and is a Conifer not dissimilar in appearance and habit to the Bournemouth specimen of *Taxodium eocænum* figured on Plate VII, fig. 3. The second is from the Park-hill cutting at Croydon, and is like, but far more slender than, the *Athrotaxis* just described, from Hordwell. A fossil completely identical with it is named *Glyptostrobus gracillimus* by Lesquereux, from the Cretaceous of Dakota. It is worth while calling especial attention to this fact, as so many of our Lower-Eocene plants have representatives in that Flora. A few specimens from the Eocene or Oligocene of Central Europe, referred generally to *Widdringtonia*, almost rival it in delicacy; but, so far as I am aware, no existing Conifer has such slender foliage.

[1] "Flora of Bovey," 'Phil. Trans.,' 1862.

[2] Gordon's 'Pinetum,' p. 47, 1880.

Order—GNETACEÆ.

The Gnetaceæ form a very distinct order of Gymnosperms. Their fruit is ovate and drupaceous, or compressed and membranaceous, and the flowers are arranged in catkins. They are characterised by their stems being jointed at every node and their ligneous tissue being marked by circular discs. The three known genera, *Welwitschia*, *Ephedra*, and *Gnetum*, are very dissimilar in appearance. While retaining the peculiarities of Gymnosperms they present a plain transition to true Exogens.

Welwitschia is a most singular and abnormal plant inhabiting the arid regions of South-west Africa, between the 14th and 23rd degrees of south latitude.

Gnetum inhabits the tropics of Asia and America, except an African and a Fijian species. There are about fifteen species known, most of which possess large ovate or lanceolate, dark, coriaceous leaves, with simple margin and anastomosing secondary veins. Although some Eocene leaves are not dissimilar, the inflorescence, the fruit, and stems are so peculiar and apparently so easily preserved, that in their complete absence from all known fossil-bearing rocks, we must for the present conclude that no *Gnetum* formed part of the European Tertiary Flora. The *Ephedræ*, however, were widely spread in at least the European Eocenes.

Genus—Ephedra, *Linn.*

The flowers are unisexual, most often diœcious. The fruit is drupaceous, oblong, indehiscent, succulent, with a hardened interior, and formed of two carpels with a single seed in each. The branches are slender, nodose, and jointed, erect or pendulous, and the leaves very small and scale-like. Some thirty species are known. They are erect or scandent, apparently leafless shrubs, copiously branching and abounding on the sandy sea-shores of Eastern Europe, North Africa, temperate and sub-tropical Asia, and extra-tropical America, from Chili to California. They closely resemble *Casuarinæ*, but a critical examination enables their stems to be distinguished.

Their peculiar jointed and striated stems can be picked out in abundance from the innumerable masses of pyritised twigs left by the tide at Sheppey. I have also met with a fruit, apparently a thin oval shell of the size of a small nutmeg kernel, labelled "Gnetum," but probably intended for *Ephedra*, in the Bowerbank Collection from Sheppey; but it is now in fragments, and I am unable to restore it. There is no doubt, however, that a species of *Ephedra* similar to that now living on the shores of the Mediterranean formed part of the Sheppey fossil Flora.

I have also come across a stone perforated with twigs which have all the characters of *Ephedra*, on the shore of Lough Neagh.

Species have been described by Unger, from Sotzka; by Heer, from Switzerland; and by Ettingshausen, from Häring.

PLATE X.

Sequoia ? Langsdorfii, Brongn., sp.

Fig. 1. Branch, originally figured as *Taxites Campbellii*, 'Quart. Journ. Geol. Soc.,' vol. vii, pl. ii, fig. 1 *a*, *b*.

1 *a*. Portion enlarged to show mode of attachment of leaflets to branch.

(From the Basaltic Formation, Isle of Mull. In the Jermyn Street Museum.)

Cryptomeria Sternbergii, Goeppert, sp.

2. A specimen from the Isle of Canna. (In the Edinburgh Museum.)

3. Branchlet from Mull. (In the Glasgow University Museum.)

3 *a*. Part magnified.

Taxus Swanstoni, sp. nov.

4. Branchlet.

5. Another example.

4 *a*, 4 *b*. Portions enlarged with abortive leaflets.

(From the Basaltic Formation, Ballypalady. In the Author's Collection.)

Athrotaxis Couttsiæ, Heer, sp.

6, 8. Foliage.

7. Foliage and cone.

7 *a*. The same enlarged.

9. A cone.

(From the Upper Eocene, Hordwell. In the Author's Collection.)

Cryptomeria Sternbergii, Goeppert, sp.

10—13. Cones showing exterior forms of some of the scales.

(From the Basaltic Formation, Ballypalady.)

PLATE XI.

From the Middle Bagshot, Bournemouth.

Araucaria Goepperti, Sternb., sp.

Fig. 1. Impression of foliage in sandy clay, showing variations due to the seasons.

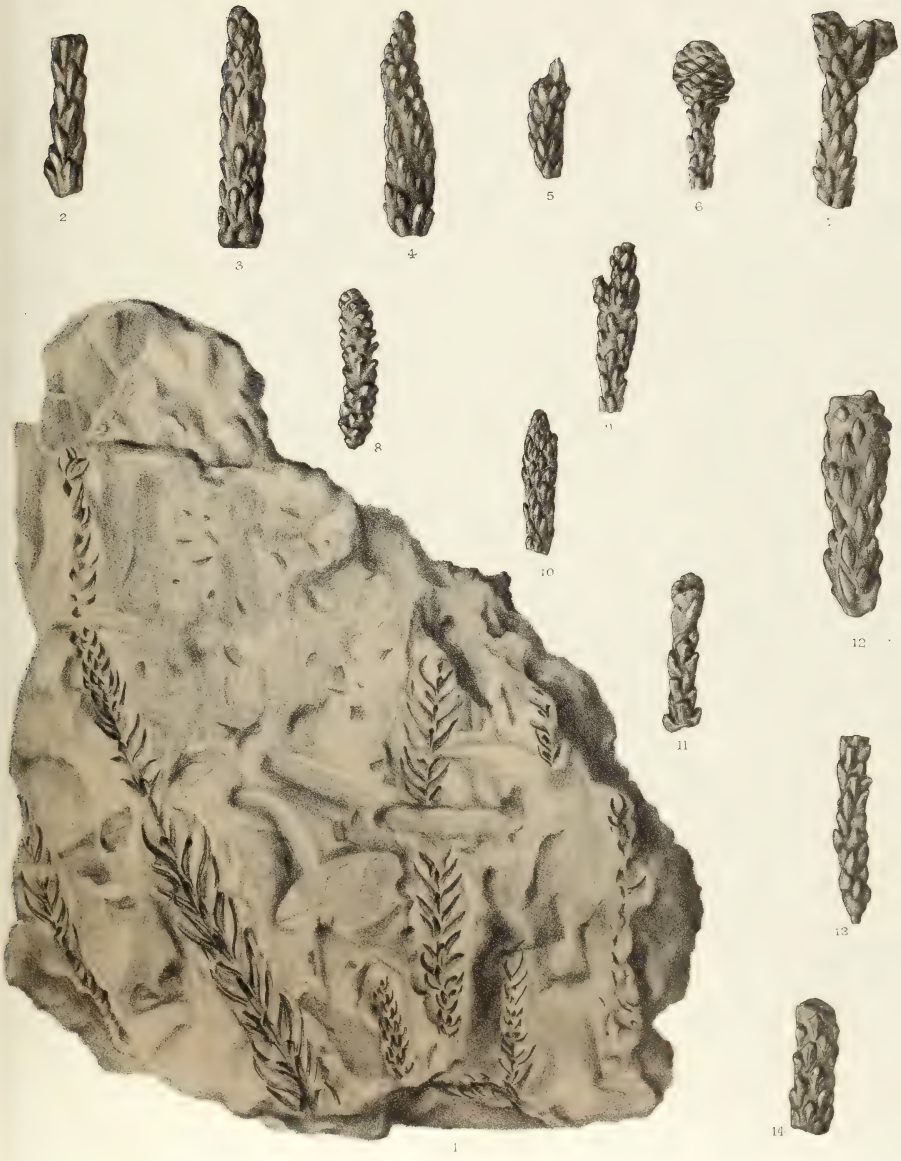
(Author's Collection.)

From the London Clay, Sheppey.

Athrotaxis subulata, sp. nov.

2—14. Fragments of foliage showing disposition and different types of leaflets.
6. Mature cone attached to branch.

(Figs. 6—10 in the Author's Collection, the remainder in the British Museum.)



EOCENE CONIFERÆ.

C. C. Woodward del. et lith.

West, Newman & Co. imp.

PLATE XII.

MIDDLE BAGSHOT, BOURNEMOUTH.

Araucaria Goepperti, Sternb.

Fig. 1. Part of a perfect branchlet ; *a*, swollen bud ; *b*, ordinary bud.
2. A smaller specimen of foliage.

(From the Author's Collection, now in the British Museum.)

Fig. 2

Fig. 1

PLATE XIII.

Pinus Dixoni, Bowerbank, sp.

Fig. 1. Cone.
2. Reverse of Fig. 1.
8. Another specimen.

(From the Middle Bagshot, Bracklesham. Woodwardian Museum, Cambridge.)

4. Somewhat abraded cone, presumed to be of the same species as above.

(From the Bembridge Marls, Gurnet Bay. In the possession of Mr. J. A'Court Smith.)

5. Much abraded cone.

(From the Middle Bagshot, Highcliff. Author's Collection.)

Pinus Prestwichii, sp. nov.

3. Impression of the cone.

(From the Thanet Beds, Herne Bay. In Professor Prestwich's Collection.)

Pinus Bowerbankii, Carr., sp.

6. Imperfect cone.

(From the Middle Bagshot, Highcliff.)

9. Imperfect cone.

(From the Middle Bagshot, Bracklesham. Author's Collection.)

Araucaria Goepperti ?, Sternb., sp.

7. Branchlet, with long and slender leaflets.

(From the Bembridge Marls, Hempstead. Author's Collection.)

10. Branchlet. (From the Middle Bagshot, Highcliff. British Museum.)

G.M. Woodward del. et lith.

EOCENE CONIFERÆ.

Wm. Norman & Co. imp.

PLATE XIV.

From the Thanet Beds, East Kent.

Pinus macrocephalus, Lindley and Hutton, sp.

Figs. 1, 2. Section of cone, parallel to the axis, showing internal structure.
6. Fragment of a cone.
7. Entire cone, showing internal and external structure.

(British Museum.)

Pinus ovata, Lindley and Hutton, sp.

4, 5. Transverse sections of cone.

(British Museum.)

From the London Clay, Sheppey.

Pinus Bowerbankii, Carr., sp.

3. Much abraded specimen, showing seeds adhering to the axis.
8. A similar specimen.

(British Museum.)

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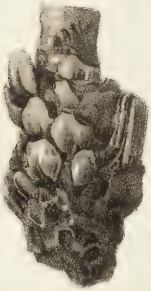
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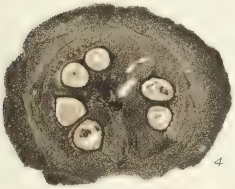
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PLATE XV.

From the Basaltic Formation, Ballypalady.

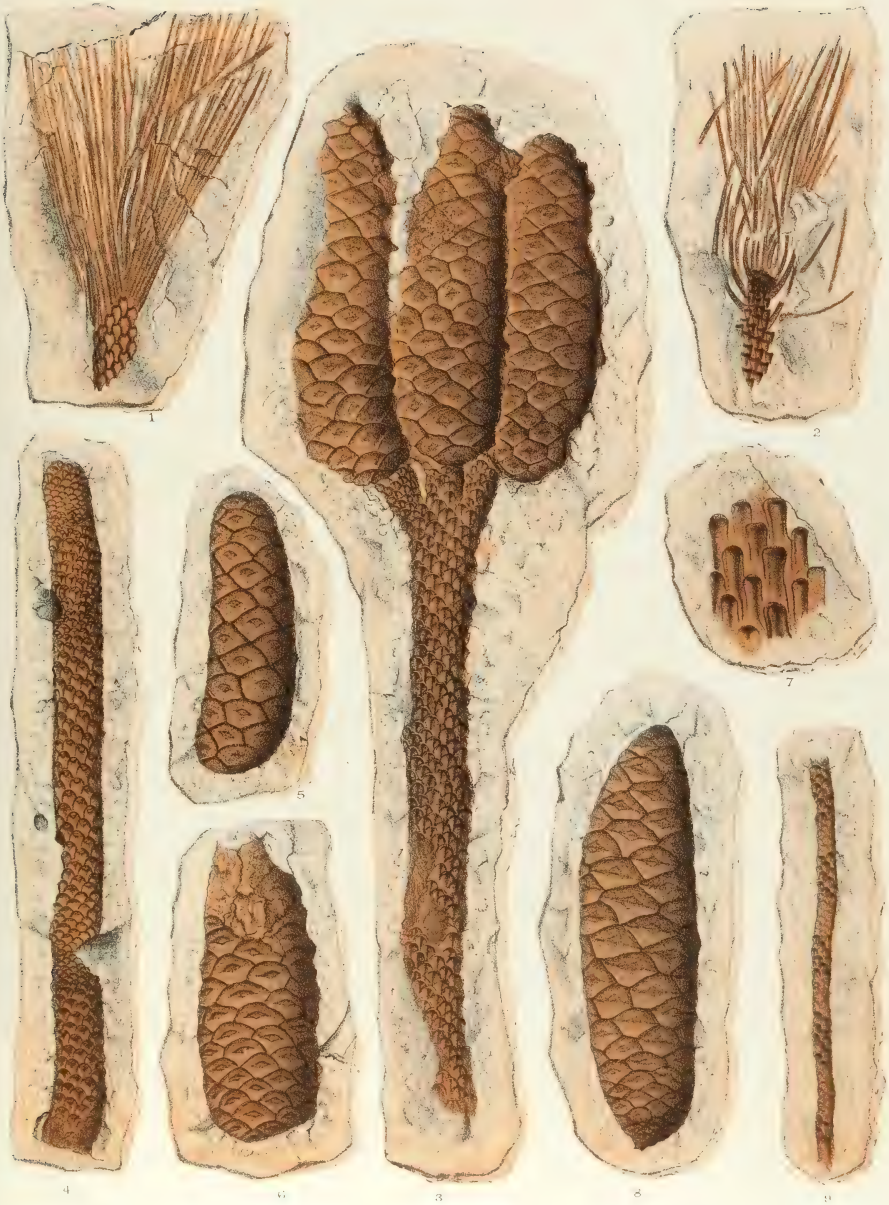
Pinus Plutonis, Baily.

Fig. 1. Branchlet showing attachment of needles. Their entire length is not shown.
3. Branch with three cones attached, showing erect position of growth.
4. Branch with leaf scars.
6. Pine cone.
7. Fragment of bark, with older leaf scars.
8. Perfect cone.

Pinus Bailyi, sp. nov.

2. Branchlet with needles.
5. Perfect cone.
9. Branchlet.

(Figs. 1, 3, 7, in the Belfast Museum, the rest in the Author's Collection.)



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EOCENE CONIFERÆ.

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PLATE XVI.

From the Basaltic Formation, Ballypalady.

Tsuga Heerii, sp. nov.

Fig. 1. Impression of cone.
2. Smaller cone on stem.
3. Smaller, possibly less matured cone.
4. Another specimen with seeds. The small cone on the same block is *Cupressus Pritchardi*.
10—13. Acicular leaves, probably of same species.
14, 15. Separate scales of a leathery cone.
16. Seed, probably of *Tsuga* or *Abies*.

(Author's Collection, except figs. 3 and 11, which are in the Belfast Museum.)

Pinus Plutonis?, Baily.

5. Impression of part of axis of cone with pair of seeds towards apex.
6. Another specimen, with seeds and a pine twig.
7. More perfect specimen, showing arrangement of seeds in pairs.
17. Another specimen.

(Author's Collection.)

Cupressus Pritchardi, Goepp.

8. The upper specimen exhibits the face of the scale, the lower one the under side of scale.
9. Transverse section of cone, showing striated under surface of scale.

(Author's Collection.)

E. C. Knight lith.

EOCENE CONIFERÆ.

West, Newman & Co imp.

PLATE XVII.

From the Basaltic Formation, Ballypalady.

Pinus Plutonis, Baily.

Fig. 1. Scale of cone.
2, 3, 5. Winged seeds.
6. Double needle, perfect except the base.
7. Fragment of old bark.
8. Double needle and winged seed.
9. Needles.

(Author's Collection.)

Pinus Bailyi, sp. nov.

4. Double needle.

(Author's Collection.)

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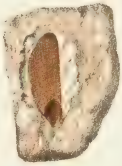

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F.C.Knight del et lith.

EOCENE CONIFERÆ.

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PLATE XVIII.

Basaltic Formation, Ballypalady.

Pinus Plutonis, Baily.

Fig. 1. Foliage of *Pinus Plutonis*, Baily, with cluster of three cones of *Cupressus Pritchardi*, Goepp., in transverse section, and single cone showing under side of scales.

2. Foliage attached to branch, reduced by one fourth.
3. Closed cone with footstalk.
4. Male catkin.
5. Right-hand impression, branch with leaf scars; left-hand do., part of closed cone; centre do., partly opened cone with seeds.

(Author's Collection.)

1

3

2

4

5

F.C. Knight del. et lith.

EOCENE CONIFERÆ.

West, Newman & Co. imp.

PLATE XIX.

From the Basaltic Formation, Ballypalady.

Cupressus Pritchardi, Goepp.

Fig. 1. Branch.
1 *a*, 1 *b*, 1 *c*. Portions enlarged, showing different types of foliage.
2. Another branch.
3. Fragment of foliage.
4. Branchlet.
4 *a*, 4 *b*. Portions enlarged.
5. Two cones attached.
6. Section through cone.
7—9. Cones showing forms of scale-heads.
10—13. Cones gaping or squeezed open by pressure, showing upper and under surfaces of scales.

(Author's Collection.)

EOCENE CONIFERÆ.

West Newman & Co imp

PLATE XX.

From the Basaltic Formation, Ballypalady.

Cryptomeria Sternbergii, Goepp., sp.

Fig. 1. Foliage.
1 *a*, 1 *b*, 1 *c*. Portions enlarged.
2. Specimen with longer and straighter leaflets.
3. Foliage and cone.
3 *a*, 3 *b*. Portions of foliage enlarged.
4. Foliage and part of cone enlarged.
5. Foliage. The thickening seen in two places is due to lateral shoots being pressed against the main stem.
6. Foliage and fimbriated scale of cone.
6 *a*. Portion enlarged.
7—13. More or less broken cones.

(Author's Collection.)

EOCENE CONIFERÆ.

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A MONOGRAPH

OF THE

BRITISH FOSSIL

BIVALVED ENTOMOSTRACA

FROM THE

CARBONIFEROUS FORMATIONS.

BY

PROFESSOR T. RUPERT JONES, F.R.S., G.S., &c. &c.;

JAMES W. KIRKBY, ESQ., &c. &c.;

AND

PROFESSOR GEORGE S. BRADY, M.D., F.R.S., F.L.S., &c., &c.

PART I. No. 2.

THE CYPRIDINADÆ AND THEIR ALLIES.

CONTAINING

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LONDON:

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PART I.

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Order.—PLATYCOPA. (See page 6.)

Family.—CYTHERELLIDÆ.

CYTHERELLIDÆ, *G. O. Sars*, 1865. Oversigt af Norges marine Ostracoden: Forhandlinger i Videnskabs-Selskabet i Christiania, Aar 1864 (8vo, 1865), p. 124.
— *G. S. Brady*, 1866. Trans. Zool. Soc., v, p. 361.
— *G. S. Brady*, 1867. Intellectual Observer, xii, p. 116.
— *G. S. Brady*, 1868. Trans. Linn. Soc., xxvi, pp. 359 and 472.
— *Jones*, 1870. M. Microsc. Journ., iv, p. 187.
— *G. S. Brady*, 1878. Trans. Zool. Soc., x, p. 407.
— *G. S. Brady*, 1880. The Zoology of the Voyage of H.M.S. 'Challenger,' part iii, Report on the Ostracoda, p. 171.

This family is widely represented in the existing seas, and has long been represented in past time, by one genus, the typical *Cytherella*. *Cytherellina* and *Æchmina* are grouped with it. There is also another form which Dr. G. S. Brady finds to be distinct from other Ostracods, and most nearly allied to *Cytherella*, though separated by some important features. This is the *Bosquetia*, B. C. and R., 'Monograph Post-Tertiary Entom.,' Pal. Soc., 1874, p. 220.

1. *Genus* CYTHERELLA (*Cythere* et *Cytherina* auctorum[1]).

CYTHERELLA (sub-genus), *Jones*, 1848. Monogr. Entom. Cretac., pp. 6, 7, 9, 14, 28.
— *Bosquet*, 1852. Mém. Couron. Acad. Belg., xxiv, p. 91.
— *Reuss*, 1853. N. Jahrb. f. Min., &c., 1853, p. 676 (a *Cythere*).
— *Bosquet*, 1854. Mém. Commiss. Carte Géol. Neerland., ii, p. 53.
— *Reuss*, 1854. Deutsch. Akad. Wiss. Wien, vii, p. 140.
— *Reuss*, 1855. Zeitsch. Deutsch. geol. Gesell., vii, p. 277.
— *Bornemann*, 1855. Zeitsch. Deutsch. geol. Ges., vii, p. 354.
— (sub-genus), *Jones*, 1856. Monogr. Tertiary Entom., pp. 4, 6, 9, 10, 22, 54.
— *Egger*, 1858. N. Jahrb. f. Min., &c., 1858, p. 404.
— *Reuss*, 1860. Sitzungsb. math.-nat. Cl. k. Akad. Wiss. Wien, xxix, p. 271.
— *Brady*, 1866. Trans. Zool. Soc., v, p. 361.
— *Brady*, 1867. Intell. Observ., xii, p. 129.
— *Brady*, 1868. Trans. Linn. Soc., xxvi, p. 472.
— *Jones*, 1869. Palæoz. Biv. Entom., Geol. Assoc., p. 5.
— *Jones*, 1873. Month. Microsc. Journ., x, p. 75.

[1] See Chronological List of the *Cytherellæ* further on.

CYTHERELLA *H. Woodward*, 1877. Catal. Brit. Fossil Crustacea, p. 109.
— *Brady*, 1878. Trans. Zool. Soc., x, p. 407.
— *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, p. 194.
— *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 249.
— *Brady*, 1880. Report Ostrac., p. 171.

Carapace bivalved, oblong or subovate, compressed, especially in front. Valves unequal, thick, mostly plain and even, but occasionally raised in low undulations, ridges, or knobs; surface generally smooth, but sometimes pitted, reticulate, or granulose; terminal denticulations rare. Contact-margin of the right (larger) valve grooved or rabbetted on its inner edge for the reception of a flange presented by the contact-margin of the left (smaller) valve; both groove and flange stronger at the posterior than at the anterior portion of the valve. A small roundish depression near the centre of the valve externally is represented within by a faint elevation or tubercle; and in this the *lucid spots* are arranged in a transverse, curved, pinnate, or plume-shaped series of from twelve to sixteen, linear-oblong in shape, and usually increasing in length towards the ventral margin.

Of the internal structure of the animal we have the following particulars, from the observations of G. O. Sars:

"Antennæ very large; the upper many-jointed, and geniculate at the base; the lower broad and flattened, with a large pectinato-setose palp. Three pairs of hinder limbs, scarcely pediform; the two anterior pairs branchial, the others rudimentary. Abdomen terminating in two very small, narrow, and spiniferous laminæ."

"From this definition of the genus," G. S. Brady observes, "it will be seen that it differs very remarkably from all hitherto known forms, presenting in the conformation of the lower antennæ a remarkable approach to the *Copepoda*, and in the palps of the mandibles and first pair of jaws a likeness to the *Sididæ*. The way in which the animal uses its powerful limbs is not known, it never having been observed in the living state."—G. S. Brady, 'Trans. Linn. Soc.,' xxvi, p. 473.

The following Synopsis of the known species, fossil and recent, arranged according to date of publication, will be useful. The dates placed in parentheses belong to species previously described.

List of the known CYTHERELLÆ and BOSQUETIA, *arranged according to date of publication.*

[In many cases the species, and in some instances the genus, requires re-examination.]

1830 Cytherella compressa (*Cythere*, Münster), Jahrb. f. Min. &c., 1830, p. 64. Tertiary.

1830 — ? inflata (*Cythere*, Münster), Jahrb. f. Min. &c., 1830, p. 65, No. 17. Carboniferous.

(1835) Cytherella compressa (*Cythere*, Münster), N. Jahrb. f. Min. &c., 1835, p. 445. Tertiary.

1838 — Muensteri (*Cytherina*, Römer), Neues Jahrb., 1838, p. 516, No. 13, pl. 6, f. 13. Tertiary.

(1838) — compressa (*Cythere*, Münster, and *Cytherina*, Römer), Neues Jahrb., 1838, p. 517, No. 14, pl. 6, f. 14. Tertiary.

1838 — aciculata (*Cytherina* Römer), N. Jahrb. 1838, p. 517, pl. 6, f. 21 (*apud* Bosquet). Tertiary.

1838 [— ovata] (*Cytherina*, Lyell and Lonsdale), Elem. Geol., p. 55, woodcut, f. 19. Cretaceous.

1840 — — (*Cytherina*, Römer), Verst. Kreid., p. 104, No. 4, pl. 16, f. 21. Cretaceous.

1843 — pedata (*Cytherina*, Geinitz), Verst. Kiesling. Nachtrag, &c., p. 6, pl. 5, f. 13 (*apud* Bosquet, Mém. Com. Carte géol. Neerland., vol. ii, p. 62 = ? *C. Williamsoniana*). Cretaceous.

1845 — parallela (*Cytherina*, Reuss), Verst. Böhm. Kreid., p. 16, pl. 5, f. 33. Cretaceous.

1845 — complanata (*Cytherina*, Reuss), Verst. Böhm. Kr., p. 16, pl. 5, f. 34. Cretaceous.

(1845) — ovata (*Cytherina*, Reuss), Verst. Böhm. Kr., p. 16, pl. 5, f. 35. Cretac.

1845 — elongata (*Cytherina*, Reuss), Verst. Böhm. Kr., p. 16, pl. 5, f. 36. Cretaceous.

1845 — ? asperula (*Cytherina*, Reuss), Verst. Böhm. Kr., p. 16, pl. 5, f. 37. Cretaceous.

1846 — solenoides (*Cytherina*, Reuss), Verst. Böhm. Kr., p. 104, pl. 24, f. 14. Cretaceous.

1846 — ? amygdaloides (in part), (*Cythere*, Cornuel), Mém. Soc. Géol. France, sér. 2, i, p. 197, pl. 8, f. 5—9. Cretaceous or Neocomian.

1847 — serrata (*Cytherina*, Williamson), Trans. Manch. Phil. Soc., viii, p. 79, pl. 4, f. 79; and ser. 3, v, p. 136, 1872 (= ? *Williamsoniana*). Cretaceous.

1847 — lævis (*Cytherina*, Williamson), Trs. Manch. Ph. Soc., viii, p. 79, pl. 4, f. 80; ser. 3, v, p. 136, 1872 (= ? *Muensteri*). Cretac.

1847 — reniformis (*Cytherina*, Bosquet), Mém. Soc. R. Liége, iv, p. 356, pl. 1, f. 1, *a—f*. Cretaceous.

1847 — truncata (*Cythere*, Bosquet), Mém. Soc. R. Liége, iv, p. 357, pl. 1, f. 2, *a—e*. Cretaceous.

1847 — auricularis (*Cypridina*, Bosquet), Mém. Soc. R. Liége, iv, p. 366, pl. 3, f. 2, *a—d*. Cretaceous.

(1848) Cytherella ovata (*Cytherina*, Römer), Jones, Mon. Cret. Entom., p. 28, pl. 7, f. 24, *a—i*; and Geol. Mag., vii, 1870, p. 76. Cretaceous.

(1848) — truncata (*Cythere*, Bosquet), Jones, Mon. Entom. Cret., p. 30, pl. 7, f. 25, *a—e*; and Geol. Mag., vii, 1870, p. 76. Cretaceous.

1848 — Williamsoniana, Jones, Mon. Entom. Cret., p. 31, pl. 7, f. 26, *i*; and Geol. Mag., vii, 1870, p. 76. Cretaceous.

1848 — Williamsoniana, var. granulosa, Jones, Mon. Entom. Cret., p. 31, pl. 7, f. 26, *i*. Cretaceous.

1848 — ? Mantelliana, Jones, Mon. Entom. Cret., p. 32, pl. 6, f. 22, *a—c*; and Geol. Mag., vii, 1870, p. 76. Cretaceous.

(1849) — compressa (*Cythere*, Münster; *Cytherina*, Reuss), Haid. Abh., iii, p. 54, pl. 8, f. 15, *a*, *b*. Tertiary.

1850 — nuciformis, Jones, in King's Mon. Perm. Foss., p. 64, pl. 18, f. 11, *a—c*; Trans. Tyneside Nat. Field Club, iv, 1859, p. 40, (*Cythere*); pl. 11, f. 7, *a—c*. Permian.

(1850) — parallela (*Cytherina*, Alth), Haid. Abhandl., iii, pt. 2, p. 197, pl. 10, f. 19. Cretaceous.

(1850) — — (*Cytherina*, Reuss), Haid. Abhand., iv, p. (31) 48, pl. 6, f. 1. Cretaceous.

(1850) — ovata (*Cytherina*, Römer & Reuss), Haid., Abth. iv, p. 32, pl. 6, f. 2. Cretaceous.

1850 — Leopolitana (*Cytherina*, Reuss), Haid., Abth. iv, p. 32, pl. 6, f. 3. Cretaceous.

1850 — leioptycha (*Cypridina*, Reuss), Haid., Abth. iv, p. (33) 49, pl. 6, f. 11, *a—c*. [*Apud* Bosquet, Mém. Comm. Carte géol. Neerl., ii, p. 62, *C. Williamsoniana*.] Cretaceous.

1851 — Beyrichi (*Cytherina*, Reuss), Zeitsch. geol. Ges., iii, p. 89, pl. 7, f. 65. Tertiary.

(1852) — compressa (*Cythere*, Münster), Bosquet, Mém. Cour. Acad. Belg., xxiv, p. 11, pl. 1, f. 1, *a—f*. Tertiary.

(1852) — Muensteri (*Cytherina*, Römer), Bosquet, Mém. Cour. Acad. Belg., xxiv, p. 13, pl. 1, f. 2, *a—d*. Tertiary.

1852 — hieroglyphica, Bosquet, Mém. Cour. Acad. Belg., xxiv, p. 15, pl. 1, f. 3, *a—d*. Tertiary.

1852 — Jonesiana, Bosquet., Mém. Cour. Acad. Belg., xxiv, p. 16, pl. 1, f. 4, *a—d*. Tertiary.

(1854) — nuciformis (*Cytherella?* Jones), Reuss, Jahresb. Wetter. Ges. Hanau, für 1851-3, p. 68, pl. —, f. 9, *a*, *b*. Permian.

(1854) Cytherella ovata (*Cythere*, Römer), Bosquet, Mém. Comm. Carte géol. Neerl., p. 55, pl. 8, f. 1, *a—f*. Cretaceous.

(1854) — Muensteri (*Cytherina*, Römer), Bosquet, Mém. Comm. Carte géol. Neerl., ii, p. 58, pl. 8, f. 2. Cretaceous.

(1854) — auricularis, Bosquet, Mém. Comm. Carte géol. Neerl., ii, p. 60, pl. 4, f. 19, *a—d*. Cretaceous.

1854 — denticulata, Bosquet, Mém. Comm. Carte géol. Neerl., ii, p. 61, pl. 5, f. 1, *a—d*. Cretaceous.

(1854) — Williamsoniana, Jones, Bosquet, Mém. Comm. Carte géol. Neerl., ii, p. 62, pl. 5, f. 2, *a—d*. Cretaceous.

(1854) — Leopolitana, Reuss, Denksch. Akad. Wien, vii, p. 140, pl. 27, f. 4, *a—c*. Cretaceous.

(1854) — complanata (*Cytherina*, Reuss), Denks. Akad. Wien, vii, p. 140, pl. 28, f. 9, *a, b*. Cretaceous.

(1855) — — Reuss, Zeitsch. g. G., vii, p. 277. Cretaceous.

(1855) — nuciformis, Richter, Zeitsch. g. G., vii, p. 529, pl. 26, f. 8, 9. Permian.

(1855) — parallela, Reuss, Zeitsch. g. G., vii, p. 278. Cretaceous.

(1855) — Beyrichi (*Cytherina*, Reuss), Bornemann, Zeitsch. g. G., vii, p. 354, pl. 20, f. 1. Tertiary.

1855 — fabacea, Bornemann, Zeitsch. g. G., vii, p. 355, pl. 20, f. 2. Tertiary.

1855 — intermedia, Bornemann, Zeitsch. g. G., vii, p. 355, pl. 20, f. 3. Tertiary.

(1856) — compressa (*Cythere*, Münster), Jones, Mon. Tert. Ent., p. 54, pl. 5, f. 21, 23; Geol. Mag., vii, 1870, p. 157. Tertiary.

(1856) — — (*Cythere*, Münster), var. 1 (= *C. Beyrichi*, Born.), Jones, Mon. Tert. Ent., p. 55, pl. 5, f. 18; and Geol. Mag., vii, 1870, p. 157. Tertiary.

(1856) — — (*Cythere*, Münster), var. 2 (= *? C. intermedia*, Born.), Jones, Mon. Tert. Ent., p. 55, pl. 5, f. 19; and Geol. Mag., vii, 1870, p. 157. Tertiary.

(1856) — Muensteri (*Cytherina*, Rœmer), Jones, Mon. Tert. Ent., p. 56, pl. 5, f. 13; and Geol. Mag., vii, 1870, p. 76. Tertiary.

1856 — Londinensis, Jones, Mon. Tert. Ent., p. 55, pl. 5, f. 20, 22. Tertiary.

(1858) — Jonesiana, Bosquet, Egger, Neues Jahrb. 1858, p. 404, pl. 25, f. 1, *a—c*. Tertiary.

(1858) — compressa (*Cythere*, Münster), Egger, Neues Jahrb. 1858, p. 404, pl. 25, f. 2, *a—c*. Tertiary.

1858 — inflexa, Egger, N. Jahrb. 1858, p. 404, pl. 25, f. 3, *a—c*. Tertiary.

(1861) — nuciformis, Jones (*Cythere*, Geinitz), Dyas, p. 31, woodcut, f. 1, *a—b*. Permian.

1861 Cytherella? ovalis (*Cythere*, Stottard), Ann. Mag. N. H., ser. 3, vol. viii, p. 489, pl. 18, f. 5. Carboniferous.

(1863) — Beyrichi (*Cytherina*, Reuss), Speyer, Ostrac. Cass. Tert., p. 54, pl. 1, f. *a—c*. Tertiary.

1863 — transversa, Speyer, Ostrac. Cass. Tert., p. 56, pl. 1, f. 2, *a—c*. Tertiary.

1865 — abyssorum, G. O. Sars, Overs. Norg. Mar. Ostrac., in Forhand. Videnskab. Christiania, Aar 1864, p. 125. Recent.

(1865) — ? inflata (*Cythere*, Münster), Jones and Kirkby, Ann. Mag. N. H., ser. 3, xv, p. 408, pl. 20, f. 8, *a—c*. Carboniferous.

1865 — ampla, Terquem
1865 — breviata, Terquem
1865 — notabilis, Terquem
1865 — polita, Terquem — p. 119
1865 — propinqua, Terquem
1865 — papyracea, Terquem
1865 — tenella, Terquem
1865 — nummularis, Terquem — p. 120
1865 — Metensis, Terquem
1865 — matutina, Terquem

Mém. Soc. Géol. France, sér. 2, vol. viii, pp. 119, 120. (Only names, no figures.) Lower Lias.

1866 — subcylindrica (*Bairdia*, Sandberger), N. Jahrb. f. M., 1866, p. 41; and Verh. geol. Reichs., 1868, p. 190, and p. 210? Triassic.

1866 — pulchra, Brady, Trans. Zool. Soc., v, 361, pl. 57, f. *a—d*. Recent.

1866 — punctata, Brady, Trans. Zool. Soc., v, 362, pl. 57, f. 2, *a*, *b*. Recent.

(1866) — Beyrichi (*Cytherina*, Reuss), Brady, Trans. Zool. Soc., v, 362, pl. 57, f. 3, *a*, *b*. Recent.

1866 — rugosa, Brady, Trans. Zool. Soc., v, 362, pl. 57, f. 4, *a*, *b*. Recent.

1867 — Scotica, Brady, Brit. Assoc. Report for 1866, p. 211. Recent.

1867 — lævis, Brady, Brit. Assoc. Report for 1866, p. 211. Recent.

1867 — fraterna (*Cythere*, Reuss), Sitz. Akad. Wien, lv, Abth. i, p. 284, pl. —, f. 7. Triassic.

(1867) — nuciformis, Jones (*Cythere*, Richter), Zeitsch. D. g. G., xix, p. 227, pl. 5, f. 7. Permian.

(1867) —? inflata (*Cythere*, Münster), Jones and Kirkby, Trans. Geol. Soc. Glasgow, ii, p. 218; and iii Suppl., 1871, p. 28. Carboniferous.

1867 — simplex, Jones and Kirkby, Trans. Geol. Soc. Glasgow, ii, p. 218; and iii Suppl. 1871, p. 28. Carboniferous.

1867 Cytherella aspera, Jones, Quart. Journ. Geol. Soc., xxiii, pp. 467, 497, 503, 509, and 559. Lias.

1867 —? Gingensis (*Bairdia,* Waagen), in Benecke's Beiträge, vol. i, 1868, p. 586, pl. 34, f. 1. Jurassic.

1868 — limbata, Reuss, Sitz. Akad. Wiss. Wien, lvii, 1 Abth., p. 108. Triassic and Jurassic.

(1868) — Scotica, Brady, Trans. Lin. Soc., xxvi, p. 473, pl. 34, f. 18—21. Recent.

(1868) — lævis, Brady, Trans. Lin. Soc., xxvi, p. 474, pl. 34, f. 15—17. Recent.

1868 — cavernosa, Brady, Fonds de la Mer, p. 65, pl. 8, f. 13, 14. Recent.

1868 — semitalis, Brady, Fonds de la Mer, p. 72, pl. 8, f. 23, 24. Recent.

1869 — Raibliana, Gümbel, Jahrb. geol. Reichs., xix, p. 183, pl. 6, f. 32. Triassic.

(1869) — subcylindrica (*Bairdia,* Sandberger), Gümbel, Jahrb. geol. Reichs., xix, p. 183, pl. 6, f. 35. Triassic.

1869 —? tuberculifera [*C. tubulifera* in the explanation of the plate], (*Cythere,* Gümbel), Jahrb. geol. Reichs., xix, p. 184, pl. 6, f. 37, *a*, *b*. Triassic.

1869 — truncata, Brady, Fonds de la Mer, p. 154, pl. 19, f 3, 4. Recent.

1869 — cingulata, Brady, Fonds de la Mer, p. 159, pl. 16, f. 24, 25. Recent.

1869 — polita, Brady, Fonds de la Mer, p. 161, pl. 19, f. 5—7. Recent.

1869 — nitida, Brady, Fonds de la Mer, p. 163, pl. 19, f. 8, 9. Recent.

1870 — brevis, Jones, Month. Microsc. Journ., iv, p. 185, pl. 61, f. 4; and vol. x, 1873, p. 75. Carboniferous.

(1870) — Muensteri (*Cytherina,* Römer), var. rectipunctata, Jones, Geol. Mag., vii, p. 157 (Mon. Tert. Entom., p. 56, pl. 5, f. 12). Tertiary.

1870 — cuneolus, Brady, Fonds de la Mer, p. 192, pl. 19, f. 18, 19. Recent.

1871 — Ulmensis, Gümbel, Sitz. Akad. Wiss. math.-phys. Cl. München, 1871, p. 71, pl. 1, f. 22. Jurassic.

1871 —? — (*Bairdia,* Gümbel), Sitz. Akad. München, 1871, p. 71, pl. 1, f. 23. Jurassic.

1871 —? grossefoveata (*Bairdia,* Gümbel), Sitz. Akad. München, 1871, p. 71, pl. 1, f. 24. Jurassic.

1874 Bosquetia robusta, G. S. Brady, Crosskey, and Robertson, Mon. Post-tert. Entom., p. 220, pl. 12, f. 18—21. Post-tertiary.

1875 Cytherella Murchisoniana, Jones and Kirkby, Ann. Mag. Nat. Hist., ser 4, vol. 15, p. 57, pl. 6, f. 13, *a*, *b*, 14, *a*, *b*. Carboniferous.

1876 —? paupercula, Blake, Lias of Yorkshire, p. 433, pl. 19, f. 13. Lias.

1876 Cytherella circumscripta, Blake, Lias of Yorkshire, p. 434, pl. 19, f. 14. Lias.
1876 — crepidula, Blake, Lias of Yorkshire, p. 434, pl. 19, f. 15. Lias.
(1878) — parallela (Reuss), G. S. Brady, Trans. Zool. Soc., vol. x, p. 407, pl. 62, f. 2. Tertiary.
1878 — nodosa, G. S. Brady, Trans. Zool. Soc., vol. x, p. 407, pl. 62, f. 2. Tertiary.
1878 — elliptica, G. S. Brady, Trans. Zool. Soc., vol. x, p. 407, pl. 62, f. 6. Tertiary.
1878 — Fischeri, Terquem, Mém. Soc. géol. France, sér. 3, vol. ii, p. 94, pl. 15, f. 21, *a—d*. Tertiary.
(1880) — polita, G. S. Brady, Challenger Report, p. 172, pl. 43, f. 5, *a—c*; and pl. 44, f. 1, *a—g*. Recent.
1880 — lata, G. S. Brady, Challenger Report, p. 173, pl. 44, f. 5, *a—e*. Recent.
1880 — dromedaria, G. S. Brady, Challenger Report, p. 173, pl. 43, f. 6, *a*, *b*. Recent.
(1880) — truncata, G. S. Brady, Challenger Report, p. 174, pl. 36, f. 3, *a—d*. Recent.
(1880) — pulchra, G. S. Brady, Challenger Report, p. 174, pl. 44, f. 3, *a—b*. Recent.
(1880) — punctata, G. S. Brady, Challenger Report, p. 174, pl. 36, f. 6, *a*, *b*; and pl. 44, f. 4, *a—g*. Recent.
(1880) — semitalis, G. S. Brady, Challenger Report, p. 175, pl. 44, f. *a—e*. Recent.
1880 — venusta, G. S. Brady, Challenger Report, p. 176, pl. 43, f. 4, *a—d*. Recent.
1880 — cribrosa, G. S. Brady, Challenger Report, p. 176, pl. 26, f. 5, *a—d*. Recent.
1880 — cavernosa, G. S. Brady, Challenger Report, p. 177, pl. 36, f. 5, *a—d*. Recent.
(1880) — cingulata, G. S. Brady, Challenger Report, p. 177, pl. 43, f. 1, *a—g*, and f. 2, *a—d*. Recent.
1880 — irregularis, G. S. Brady, Challenger Report, p. 178, pl. 43, f. 3, *a—c*. Recent.
1880 — latimarginata, G. S. Brady, Challenger Report, p. 178, pl. 26, f. 7, *a—d*. Recent.

To indicate the common and the rarer modifications of form which the valves of this genus present, the following Table has been constructed. In it the chief divisions, based

on these differences, are shown to be 26 forms of Group I, having an even and smooth surface, a more or less elliptical outline, and a cuneiform profile or edge-view; and 6 having a lanceolate (not cuneiform) profile, and approaching *Bosquetia* in this respect. In the same group 13 have a punctate surface to their smooth, more or less elliptical valves, with wedge-shaped profile; and 2 have a reticulate ornament. In Group II the valves, more or less oblong, have an uneven surface; 13 of them are smooth; 1 granulose; and 8 punctate. The grouping of these little organisms does not appear to be at all coincident in detail with their "range in time."

Synoptical arrangement of the Cytherellæ *and* Bosquetia, *according to the Shape and other features of their Carapace-valves.*

CYTHERELLA AND BOSQUETIA.

I. Surface even. A. Smooth.

§ 1. Outline elliptical, more or less ovate, and suboblong; with cuneiform profile.

1.	Broadly elliptical. Cytherella brevis, Jones, 1870 . .	Carboniferous.
2.	Elliptical-ovate. Lonsdale in Lyell, 1838; Cytherella ovata, Roemer, 1840? 1841; Reuss, 1845; Jones, 1848; Reuss, 1850; Bosquet, 1854. The outline varies in the several figures	Cretaceous.
3.	Elliptical. Cytherella complanata, Reuss, 1845 (narrow), and 1854 (elliptical)	Cretaceous.
4.	Elliptical. Cytherella Leopolitana, Reuss, 1850 (subelliptical); Reuss, 1854	Cretaceous.
5.	Subelliptical. Cytherella lævis, G. S. Brady, 1868 . .	Recent.
6.	Elliptical; with pit. Cytherella compressa, Münster, 1838; Reuss, 1849: Bosquet, 1852; Jones, 1856; Egger, 1858. Outline varies in the different figures	Tertiary.
7.	Elliptical and pointed (ovate). Cytherella elongata, Reuss, 1845 .	Cretaceous.
8.	Subelliptical. Cytherella lata, G. S. Brady, 1880 . .	Recent.
9.	Subovate or subelliptical. Cytherella fabacea, Bornemann, 1855 .	Tertiary.
10.	Subovate. Cytherella nuciformis, Jones, 1850; Reuss, 1854; Richter, 1855 and 1867; Geinitz, 1861 . . .	Permian.
11.	Subovate or subelliptical; with pit; margined. Cytherella Londinensis, Jones, 1856	Tertiary.
12.	Suboblong. Cytherella truncata,[1] Bosquet, 1847; Jones, 1848 .	Cretaceous.

[1] For the *truncata* of G. S. Brady, 1869, see further on.

18. Suboblong; humped. Cytherella dromedaria, G. S. Brady, 1880 . Recent.
14. Suboblong, with anterior margin, and pinched. Cytherella? Ulmensis, Gümbel, 1871 . . . . Jurassic.
15. Oblong. Cytherella fraterna, Reuss, 1867 . . . Trias.
16. Oblong (broad). Cytherella scotica, G. S. Brady, 1868 . Recent.
17. Oblong; with pit. Cytherella pulchra, G. S. Brady, 1865 and 1880. (Not quite cuneiform in profile) . . . Recent.
18. Oblong. Cytherella Murchisoniana, Jones and Kirkby, 1875 . Carboniferous.
19. Oblong (narrow). Cytherella solenoides, Reuss, 1845 . . Cretaceous.
20. Oblong (narrow) and pinched. Cytherella parallela, Reuss, 1845 and 1850; Alth, 1850; G. S. Brady, 1878 . . } Cretaceous and Tertiary.
21. Oblong (narrow). Cytherella lævis, Williamson, 1847 (?= *Muensteri*) . . . . . Cretaceous.
22. Oblong (narrow). Cytherella Muensteri, Roemer, 1838; Bosquet, 1850; Jones, 1856 . . . . Tertiary.
23. Oblong and pinched in. Cytherella inflexa, Egger, 1858 . Tertiary.
24. Oblong and pinched in. Cytherella Fischeri, Terquem, 1878 . Tertiary.
25. Suboblong, but curved. Cytherella Gingensis, Waagen, 1868 . Jurassic.
26. Subreniform. Cytherella reniformis, Bosquet, 1847 . . Cretaceous.

I. Surface even. A. Smooth. § 2. Outline elliptical and suboblong; profile not cuneiform, but more or less lanceolate.

1. Elliptical. Bosquetia robusta, Brady, R. and C., 1874 . . Post-tertiary.
2. Elliptical. Cytherella? ovalis, Stottard, 1861 . . Carboniferous.
3. Elliptical. Cytherella? amygdaloides, in part, Cornuel, 1846 . Neocomian.
4. Suboblong, margined, and slightly pinched. Cytherella? Mantelliana, Jones, 1848 . . . . . Cretaceous.
5. Subovate. Cytherella? inflata, Münster, 1830; Jones and Kirkby, 1865 . . . . . Carboniferous.
6. Subovate. Cytherella Tatei, Jones, 1884 . . . Carboniferous.

I. Surface even. B. Punctate.

Outline ovate, subovate, suboblong, and oblong; profile wedge-like.

1. Elliptical. Cytherella elliptica, G. S. Brady, 1878 . . Tertiary.
2. Elliptical. Cytherella polita. G. S. Brady, 1869 . . Recent.

3. Elliptical (broad); with pit. Cytherella Muensteri, Roemer, 1838; Bosquet, 1852. (The published figures vary) . . Tertiary.
4. Elliptical (broad); with pit. Cytherella nitida, G. S. Brady, 1869 Recent.
5. Elliptical and oblong; with pit. Cytherella Beyrichi, Reuss, 1851; Bornemann, 1855; Speyer, 1863; G. S. Brady, 1866. (The published figures vary) . . . . Recent and Tertiary.
6. Elliptical; with anterior border. Cytherella? grossefoveolata, Gümbel, 1871 . . . . . Trias.
7. Oblong; with pit. Cytherella punctata, G. S. Brady, 1866 . Recent.
8. Oblong (broad), but tapering. Cytherella intermedia, Bornemann, 1855 . . . . . Tertiary.
9. Oblong (broad). Cytherella compressa,[1] Münster, 1838; and varieties *Beyrichi* and *intermedia*, Jones, 1856. (The published figures vary) . . . . . Tertiary.
10. Oblong. Cytherella semitalis, G. S. Brady, 1868 . . Recent.
11. Oblong. Cytherella? aciculata, Roemer, 1838 . . Tertiary.
12. Oblong (narrow). Cytherella? asperula, Reuss, 1845 . . Cretaceous.
13. Oblong, pinched; with faint pit. Cytherella transversa, Speyer, 1863 . . . . . Tertiary.

I. Surface even. C. Surface reticulate and foveolate.

Outline subovate or sub-oblong; profile cuneiform.

1. Oblong. Reticulate. Cytherella venusta, G. S. Brady, 1880 . Recent.
2. Oblong. Foveolate. Cytherella cribrosa, G. S. Brady, 1880 . Recent.

II. Surface uneven. A. Smooth.

1. Suboblong. Cytherella cingulata, G. S. Brady, 1869 . . Recent.
2. Suboblong. Cytherella crepidula, Blake, 1876 . . Lias.
3. Oblong (broad). Cytherella Williamsoniana, Jones 1848 (=? *serrata*, Wills.) . . . . . Cretaceous.
4. Oblong. Cytherella auricularis, Bosquet, 1847 and 1854 . Cretaceous.
5. Oblong. Cytherella cavernosa, G. S. Brady, 1868 . . Recent.
6. Oblong. Cytherella leioptycha, Reuss, 1850 . . Cretaceous.
7. Oblong. Cytherella Ulmensis, Gümbel, 1871 . . Jurassic.
8. Oblong; with pit. Cytherella hieroglyphica, Bosquet, 1852 . Tertiary.
9. Oblong; with pit. Cytherella denticulata, Bosquet, 1854 . Cretaceous.
10. Oblong; slightly uneven. Cytherella truncata, G. S. Brady, 1869 Recent.

[1] See note on this species in the 'Geol. Mag.,' vol. vii, 1870, p. 157.

11. Oblong; sulcate across. Cytherella subcylindrica, Sandberger, 1866; Gümbel, 1869 . . . . . Trias.
12. Oblong (narrow); margined. Cytherella Raibliana, Gümbel, 1869 Trias.
13. Oblong (narrow); with tubular spines. Cytherella? tuberculifera, *vel* tubulifera, Gümbel, 1869 . . . . Trias.

II. Surface uneven. B. Granulose.

1. Oblong (broad). Cytherella Williamsoniana, var. *granulosa*, Jones, 1848 . . . . . Cretaceous.

II. Surface uneven. C. Punctate.

1. Suboblong. Cytherella Jonesiana, Bosquet. 1852; Egger, 1858 . Tertiary.
2. Suboblong. Cytherella nodosa, G. S. Brady, 1878 . . Tertiary.
3. Suboblong. Cytherella cuneolus, G. S. Brady, 1870 . . Recent.
4. Suboblong; with pit. Cytherella rugosa, G. S. Brady, 1866 . Recent.
5. Suboblong. Cytherella latimarginata, G. S. Brady, 1880 . Recent.
6. Oblong. Cytherella circumscripta, Blake, 1876 . . Lias.
7. Oblong. Cytherella irregularis, G. S. Brady, 1880 . . Recent.
8. Oblong (narrow). Cytherella? paupercula, Blake, 1876 . Lias.

The species now about to be described can be arranged according to the grouping here adopted, as follows:

1.	Cytherella valida, nov., Pl. VI, f. 2. Oblong-ovate		Surface smooth; profile more or less cuneiform	Group I, A, § 1.
2.	— Benniei, nov. (Pl. VI, f. 3, 4, 5, 7; Pl. VII, f. 12)	Suboblong		
3.	— recta, nov., Pl. VI, f. 6, 11. Oblong			
4.	— concinna, nov., Pl. VI, f. 9, 12. Long-oval			
5.	— hibernica, nov., Pl. VI, f. 13. Ovate-oblong			
6.	— brevis, Jones, Pl. VI, f. 8. Broad-ovate			
7.	— obliquata, G. S. B., Pl. VII, f. 5. Oblong			
8.	— nuciformis, Jones (Permian), Pl. VII, f. 14. Subovate			

9.	—	æqualis, nov., Pl. VI, f. 14, 15, 16. Oblong	Surface smooth; profile not cuneiform, but more or less lanceolate or narrow-oval	Group I, A, § 2.
10.	—	Tatei, Jones, Pl. VII, f. 1. Ovate-oblong		
11.	— ?	inflata (Münster), Pl. VII, f. 2. Elliptical-ovate		
12.	—	simplex, J. & K., Pl. VII, f. 3. Elliptical		
13.	—	obesa, nov., Pl. VII, f. 10. Broad-subovate		
14.	—	sp. (undetermined), Pl. VII, f. 11. Elliptical-oblong; profile ?		
15.	—	sp. (undetermined), Pl. VII, f. 13. Subelliptical		

16. Cytherella ? rotundata, nov., Pl. VII, f. 15. Broad-elliptical. Surface punctate; profile not cuneiform. Group I, D ?

17. — scrobiculata, nov., Pl. VI, f. 10. Oval-oblong. Surface transversely wrinkled; profile cuneiform. Group I, C.

Foreign species:

18. — Benniei, var. Iowensis, nov., Pl. VI, f. 17. Elliptical. I, A, § 1.
19. — — var. intermedia, nov., Pl. VII, f. 7. Subelliptical. I, A, § 1.
20. — regularis, nov., Pl. VII, f. 6. Elliptical. I, A, § 2.
21. — — var. nov., Pl. VII, f. 9. Elliptical; profile ?.
22. — subreniformis, nov., Pl. VI, f. 18. Elliptical-ovate. I, A, § 2.
23. — sp (undetermined), Pl. VI, f. 19. Elliptical. I, A, § 2 ?.
24. — impressa, nov., Pl. VII, f. 8. Subelliptical. I, A, § 1.
25. — Richteriana, nov. (Devonian), Pl. VII, f. 4. Suboval or ovate. I, A, § 2.

In figuring the *Cytherellæ* we find it convenient to place the valves in an artificial position, with anterior end upwards (instead of to the right or to the left, as the animal would be when moving). Hence the *height* of the valves seems on the plates to be the *breadth*, and is so referred to sometimes in the text. The most convex of the two long margins is usually the ventral, and the muscle-spot, as a rule, is nearest to that edge.

1. Cytherella valida. Sp. nov. Plate VI, figs. 2 *a*—*c*.

Carapace rather large, ovate or suboblong, with unequally round ends, oblique on the front edge, neatly semicircular behind; compressed; rather more convex and somewhat narrower (lower) behind. Valves stout, smooth.

Length 1·4; height ·8; thickness ·56 mm. Proportions 35 : 20 : 14.

From the Mountain-limestone series at Calees, in East Cumberland. Collected by the Rev. Walter Howchin, F.G.S.

Some casts from near Carluke, collected by the late Mr. Grossart, Pl. VII, figs. 13 *a*, *b*, *c*, somewhat approach *C. valida* in size and outline.

2. Cytherella Benniei, sp. nov. Plate VI, figs. 3 *a*, *b*; 4 *a*, *b*; 5 *a*, *b*; 7 *a*, *b*; and Plate VII, figs. 12 *a*—*d*.

Carapace mostly small, suboblong, rather variable, but higher (broader) behind than in front; edge-view sublanceolate, thickest in the posterior third, but slightly varying in individuals. Surface smooth.

	mm.	mm.	Proportions.	
Length	1·04	·8	26	20
Height	·64	·4	16	10
Thickness	·48	·32	12	8

Fig. 3, from the Hosie Limestone, at the head of Mousewater,[1] Wilsontown, Lanarkshire, was collected by Mr. Bennie for the Geological Survey of Scotland.

Figs. 4 and 5, from the Carboniferous Limestone, Calderside, near High Blantyre,[2] were collected by Mr. John Young, F.G.S. Fig. 4 is rather more parallel-edged than the other.

Fig. 7, from the Carboniferous Limestone series (upper) of Kennoway Den, in Fife, is larger than the other examples of this species.[3]

[1] 'Catal. W.-Scot. Fossils,' 1876, p. 92. The geology of the Western Scotland is succinctly given by J. Armstrong, John Young, D. Robertson, and Dr. J. Young, in this valuable little book, which is an improved form of the Supplement of vol. iii, 'Trans. Geol. Soc. Glasgow,' 1871.

[2] 'Catalogue of the Western-Scottish Fossils,' 1876, p. 68.

[3] We have examples of great difference in size among individuals of one species, from the Carboniferous Rocks, in the various representatives of *Leperditia Okeni*, from the Mountain-limestone and the Coal-measures. In the present case a larger variety than those here referred to is seen in the var. *Iowensis*, pl. vii, fig. 17, p. 80.

Fig. 12 of Plate VII is from a specimen collected by Mr. David Robertson, F.G.S., of Glasgow, from the Musselband-ironstone of the Swinehill Colliery,[1] near Stonehouse, Lanarkshire.

This species is named after Mr. James Bennie, Collector to the Geological Survey of Scotland, who has greatly aided ourselves and others in research among the Microzoa of the Carboniferous Rocks.

3. Cytherella recta. Sp. nov. Plate VI, figs. 6 *a*, *b*; 11 *a*, *b*.

Carapace neatly oblong, with round ends, and straight, parallel ventral and dorsal edges, which, however, are sometimes rather incurved; profile more than half as thick as the height of the valves, slightly compressed anteriorly, and only slightly swollen posteriorly. Muscle-spot occasionally visible.

	mm.	mm.	Proportions.	
Length	·84	·76	21	19
Height	·48	·36	12	9
Thickness	·28	·28	7	7

Fig. 11, from the Hosie Limestone or Shale at the Head of Mousewater, near Wilsontown,[2] Lanarkshire (Geol. Survey Scotland), has an unusual swelling at the postero-ventral margin, but the force of this exceptional irregularity is overruled by the typical compression.

Fig. 6, also collected by the Geol. Survey of Scotland, is from the Upper Limestone Series, at Auchenbeg,[3] Lesmahago. It occurs also in shale of the Lower Limestone Series at Thornton,[4] East-Kilbride district, Mr. D. Robertson's collection.

Reuss's *C. parallela*, in Haidinger's 'Abhandl.,' iv, pl. 6, fig. 1, is much like our *C. recta*, but is sharper in the profile anteriorly, and relatively fuller behind.

4. Cytherella concinna. Sp. nov. Plate VI, fig. 9 and figs. 12 *a*, *b*; figs. 19 *a*, *b*?

Carapace subovate, or rather long-ovate; smooth; profile bluntly lanceolate, narrowed in front, truncated behind. These two specimens, though not quite coinciding in outline, will scarcely bear parting. Fig. 12 is narrow-obovate, inasmuch as its front end is rather broader than the other. Fig. 19 possibly belongs to this species.

Length 1·16; height ·6; thickness ·44 mm. Proportions 29 : 15 : 11.

[1] 'Catal. W.-Scot. Fossils,' 1876, p. 90.

[2] Lower Limestone Series, 'Catal. W.-Scot. Fossils,' 1876, p. 92.

[3] 'Catal. W.-Scot. Fossils,' 1876, p. 86. We have before now referred to *C. recta* from Auchenbeg as "*C. parallela*, J. and K.," see the 'Explan. Sheet 31, Geol. Surv. Scotl.,' 1879, p. 83.

[4] 'Catal. W.-Scot. Fossils,' 1876, p. 81.

Fig. 9, showing the smaller valve, and probably figured with the front end downwards, is among the specimens from East Kilbride, collected and mounted by the Rev. D. Ure, and preserved in the Hunterian Museum, at the Royal College of Surgeons, London.

Fig. 12 is a view of the larger valve of a *Cytherella* from the Mountain-limestone of Holwell,[1] Somerset, in the collection of the late Mr. Charles Moore, F.G.S., of Bath. The latter is comparable with Reuss's figure of *C. complanata*, 'Denksch. Akad. Wien,' vii, p. 140, pl. 28, f. 9, but it is longer in proportion.

5. Cytherella hibernica. Sp. nov. Plate VI, figs. 13 *a*, *b*.

Carapace-valve broad (high), subovate, one edge straighter than the other; much compressed; anterior border well-rounded, but rather obliquely; posterior almost truncate. Smooth; muscle-spot distinct. Profile narrow-lanceolate.

Length ·76; height ·44; thickness ·24 mm. Proportions 19 : 11 : 6.

This compressed form is in a yellow shale of the Carboniferous Series of Ireland, from Cultra, on Belfast Lough, not far from Holywood. The locality and its strata are referred to in the 'Mem. Geol. Surv. Ireland, Explan. Sheets 37, 38, and 29,' 1871, pp. 10, 16. Also in the 'Ninth Annual Report Belfast Nat. Field-Club,' 1872, p. 35.

This *Cytherella*, associated with *Beyrichia multiloba* (?) and *Estheria tenella*, was kindly communicated by Mr. W. H. Baily, F.G.S. It may have been somewhat flattened by pressure, but its relative breadth (height) and extreme compression distinguish it from its Scotch ally *C. Benniei*, figs. 3—5, &c.

6. Cytherella brevis, *Jones*. Plate VI, figs. 8 *a*, *b*.

Cytherella brevis, *Jones*. Monthly Microsc. Journ., vol. iv, October, 1870, p. 185, pl. lxi, fig. 4; and vol. x, 1873, p. 75.

Carapace-valve broadly ovate, short; compressed, especially in front; smooth; rather straighter on one margin than on the other; ends round.

Length ·76; height ·56; thickness ·24? mm. Proportions 19 : 14 : 6?

Collected by Mr. John Young, F.G.S., in the Campsie district,[2] in a calcareous rock, six feet above the Eurypterus-limestone, Lower Limestone Series.

[1] See 'Quart. Journ. Geol. Soc.,' xxxvii, p. 68.

[2] 'Catal. W.-Scot. Fossils,' 1876, p. 70.

7. Cytherella obliquata, *G. S. Brady*, MS. Plate VII, figs. 5 *a—d*.

Carapace suboblong, or oblong with round ends, which are nearly but not quite equal in curvature; moderately convex, compressed forward and thick behind, giving an acute-ovate profile, and a suboval end-view. Surface smooth, marked with two oblique indentations in the antero-dorsal region.

Length ·52; height ·36; thickness ·24 mm. Proportions 13 : 9 : 6.

From the Carboniferous Shales at Capelrig Quarry,[1] Lanarkshire. In Mr. D. Robertson's collection.

8. Cytherella nuciformis, *Jones*. Plate VII, figs. 14 *a—c*.

Cythere (Cytherella?)	nuciformis,	*Jones*.	In King's Monogr. Perm. Foss., Pal. Soc., 1850, p. 64, pl. 18, figs. 11 *a—c*.
Cytherella	nuciformis,	*Reuss*.	Jahresb. Wetterauer Ges., 1854, p. 68, f. 9.
—	—	*Richter*.	Zeitsch. deutsch. geol. Gesell., vol. vii, 1855, p. 529, pl. 26, figs. 8, 9.
Cythere	—	*Jones*.	In Kirkby's Permian Entomostraca, Trans. Tyneside Nat. Field-Club, vol. iv, 1859, p. 40, pl. 11, figs. 7 *a—c*.
—	—	*Geinitz*.	Dyas, 1861, p. 31, figs. 1 *a—b*.

We include this little Permian species among the Carboniferous series, because of the intimate relationship of the fossils of the two formations. It has a subovate, smooth carapace, rather straighter on one edge than on the other; the profile is compressed-ovate, truncate posteriorly; end-view suboval, nearly round.

Length ·28; height ·16; thickness ·12 mm. Proportions 7 : 4 : 3.

Permian: Byer's Quarry, Sunderland; and in Germany, near Hanau and near Saalfeld.

In King's 'Monogr. Permian Foss.,' p. 63, another doubtful species was referred to as "*Cythere* (*Cytherella?*) *inornata*, M'Coy;" and this has been quoted by Richter ('Zeitsch. d. g. Ges.,' vii, 1855, p. 529) as "*Cytherella inornata*, M'Coy," and by ourselves ('Trans. Tynes. F. Club,' iv, 1859, p. 160) as "*Cythere inornata*, M'Coy." We very much doubt if it be a *Cytherella;* and we are certain that M'Coy's "*Cythere inornata*" is a dwarf form of *Leperditia Okeni* (see 'Ann. Mag. Nat. Hist.,' ser. 3, vol. xviii, 1866, p. 44). Should this Permian species ultimately prove to be a *Cytherella,* it will stand as *C. inornata*, Richter.

[1] 'Catal. W.-Scot. Fossils,' 1876, p. 79.

9. Cytherella æqualis. Sp. nov. Plate VI, figs. 14 *a*, *b*; 15 *a*, *b*; 16 *a*, *b*.

The carapace, as with *C. recta*, is smooth and oblong, with round ends, but it is nearly cylindrical; the dorsal and ventral edges vary a little in their parallelism and their compression. The edge-view differs from that of *C. recta* in being relatively thicker, and more equal at the ends, although the three examples figured vary among themselves. Fig. 14 *b* is compressed oval; fig. 15 *b* is subovate, compressed, and more convex posteriorly; and fig. 16 *b* has a marked medial convexity, but neither of its ends is acute.

Length ·6; height ·28; thickness ·24 mm. Proportions 15 : 7 : 6.

Fig. 14 is sketched from a specimen collected by Dr. H. B. Holl, F.G.S., in the Carboniferous Limestone of Great Orme's Head, North Wales. Another specimen, with a more cuneiform profile, and one much more convex, have since turned up in his collection.

Figs. 15 and 16 represent some specimens from the Upper Limestone Series at Gare,[1] near Carluke, collected by Mr. John Young, F.G.S., of Glasgow.

10. Cytherella Tatei, *Jones*. Plate VII, figs. 1 *a*, *b*, *c*.

Cytherella Tatei, *Jones*. Proceed. Berwickshire Naturalists' Club, vol. x, 1884, p. 323, pl. 2, figs. 1 *a*, *b*, *c*.

Carapace-valves small, subovate, smooth, broad (high) in front, convex medially, but more compressed forward than behind. Breadth (height) equal to about two thirds of the length. Profile or edge-view lanceolate; end-view short-ovate.

Length ·72 (one specimen ·75); height ·46; thickness ·36 mm. Proportions 18 : 11½ : 9.

Collected by the late Mr. G. Tate, F.G.S., of Alnwick, in the Lower Mountain-limestone group at Lamberton, Berwickshire. In the Alnwick Museum.

11. Cytherella ? inflata (Münster), *Jones & Kirkby*. Plate VII, figs. 2 *a*, *b*.

Cythere inflata, *Münster*. Jahrb. für Min., &c., 1830, p. 65, No. 17.
Cytherella ? inflata, *Jones & Kirkby*. Ann. Mag. N. Hist., 1865, ser. 3, vol. xv, p. 408, pl. 20, figs. 8 *a*—*c*.
— — *Jones & Kirkby*. Trans. Geol. Soc. Glasgow, vol. ii, 1867, p. 218; and vol. iii, 1871, Supp., p. 28.
— — *A., Y., & R.* Catal. W.-Scot. Foss., 1876, p. 44.
— ? — *H. Woodward*. Catal. Brit. Foss. Crust., 1877, p. 109.

[1] 'Catal. W.-Scot. Fossils,' 1876, p. 73.

Carapace convex, broad-ovate, one edge rather straighter than the other; pinched anteriorly, convex medially and along the ventral region; gently compressed behind. End-view (of cast) inversely cordate. Muscle-spot distinct.

Length 1·4; height ·92; thickness ·64 mm. Proportions 35 : 23 : 16.

Casts of this form, which we still place under *Cytherella* with some doubt, are not common in the Carboniferous (marine) Shales of Craigenglen,[1] Campsie, collected by Mr. John Young, F.G.S. It has also been collected by the Geological Survey of Scotland at Burniebrae Burn, near Shield's Farm, not far from Milton of Campsie; at Woodhall, Water of Leith, in a band of marine shale in the Cement-stone group; at Side old quarry, Midlothian; at the Salton Limeworks, new quarry, East Lothian, and at Sunnybank Quarry, near Inverkeithing. It occurs also in the Carboniferous Limestone of Visé, Belgium, and in that of Hof, in Bavaria.

12. Cytherella simplex, *Jones & Kirkby*, MS. Plate VII, figs. 3 *a*, *b*.

Cytherella simplex,	*J. & K.*	Trans. Geol. Soc. Glasgow, vol. ii, 1867, p. 218; vol. iii, 1871, Suppl., p. 28.
—	—	*Armstrong, Young, & Robertson.* Cat. W.-Scot. Fossils, 1876, p. 44.
—	—	*H. Woodward.* Cat. Brit. Foss. Crust., 1877, p. 110.

Carapace-valves broad-elliptical, slightly irregular on one margin; strongly convex in the middle, making an acute-elliptical profile. Smooth; muscle-spot distinct.

Length 1·12; height ·8; thickness ·64 mm. Proportions 28 : 20 : 16.

Collected by the late Mr. Grossart in the Lower Limestone Series of Scotland, 350 fathoms below the Ell Coal, Rae's Gill, near Carluke.[2]

13. Cytherella obesa. Sp. nov. Plate VII, figs. 10 *a*—*c*.

Carapace small, subtrigonal-ovate, swollen on one margin, much less convex on the other. Surface smooth, almost uniformly convex, but fuller behind than in front. Profile narrow-ovate; end-view blunt-oval.

Length ·32; height ·24; thickness ·18 mm. Proportions 16 : 12 : 9.

From West Broadstone,[3] in the Beith District, in West Scotland, where the Lower Limestone Series is very rich with Fossils.

14. Cytherella (?). Sp. Plate VII, fig. 11.

This is the internal cast of a subelliptical, moderately convex valve, straight on one

[1] 'Cat. W.-Scot. Foss.,' 1876, p. 70. [2] Ibid., p. 75. [3] Ibid., p. 67.

edge and symmetrically curved on the other; but not sufficiently characterised for a name.

Length ·44; height ·26; thickness ? mm. Proportions 22 : 13 : ?.

From the Mountain-limestone Shale of Wyebourne, near Penrith, Cumberland. Collected by Mr. Bland.

15. Cytherella (?). Sp. Plate VII, figs. 13 *a*—*c*.

Of several casts, seemingly belonging to *Cytherellæ*, and obtained by the late Mr. Grossart (of Salsburg, near Holytown) from the Lower Carboniferous Beds, six feet above the Eurypterus Limestone of Lanarkshire, we here figure side-views of two valves and a profile of another. There is much variation as to ellipticity and marginal contour among the specimens, and no special character to enable us, after full consideration, to come to a definite conclusion as to the alliance of these carapace-valves. They seem to be closely related to *C. valida*, page 70. We have some like them from the Carboniferous Limestone of Belgium and elsewhere.

	mm.	mm.	Proportions.	
Length	1·28	1·2	32	30.
Height	·68	·72	17	18.
Thickness	·4	?	10	?

16. Cytherella ? rotundata. Sp. nov. Plate VII, figs. 15 *a*—*c*.

Carapace broad-elliptical, uniformly convex, with greatest convexity central. Profile narrow-oval; end-view subovate. Specimens not well preserved; some apparently punctate.

Length ·64; height ·5; thickness ·34 mm. Proportions 32 : 25 : 17.

Collected by the Geological Survey of Scotland, at Mayfield Quarry, near Dalkeith. A specimen rather more ovate than fig. 15 *a*, and faintly punctate, was collected by Mr. D. Robertson, in the Lower Limestone Series, at Burnbank, Carluke.[1]

If this be a *Cytherella*, which is doubtful, it differs much from any common style of the genus, belonging, as it does, to Group I, B, punctate, *not cuneiform*.

17. Cytherella scrobiculata. Sp. nov. Plate VI, figs. 10 *a*—*e*.

Carapace oval-oblong, broad (high), and stout, ends nearly equal, but somewhat variable. Profile narrow-ovate. Pit of the muscle-spot often visible. Surface ornamented

[1] 'Cat. W.-Scot. Foss.,' p. 71.

with a transverse wrinkly reticulation, of variable strength; the meshes sometimes strong, long, and with a tendency to be concentric; sometimes faint and scarcely discernible.

Length ·84; height ·6; thickness ·44 mm. Proportions 23 : 15 : 11.

This is a rather common form. It occurs among the Carboniferous Entomostraca from East Kilbride,[1] in the Hunterian Museum (R. Coll. Surgeons), as collected and mounted by the Rev. D. Ure and given to John Hunter; also collected by Mr. D. Robertson, F.G.S., from the Upper Limestone Series at Williamswood,[2] near Glasgow; Brockley, Lesmahagow;[3] Calderside[4] Quarry, Lanarkshire; Calderwood,[5] No. 1 limestone quarry; and Limekilns, East Kilbride; and at Robroystone,[6] by Mr. John Young, F.G.S. Also, by the Geological Survey of Scotland, at Wilsontown[7] (Head of Mousewater), in the Hosie Limestone; at Boghead, Hamilton,[8] in shale between the limestones Nos. 1 and 2 of the Calderwood series; and on the River Avon,[9] below Kinneil Mill, Linlithgowshire.

With reference to the preservation of some of the above-mentioned specimens (such as figs. 9 and 10 *a*) in the Hunterian Museum, we may mention that in 1793 the Rev. David Ure, of Rutherglen, noticed the existence of certain "microscopic bivalved shells" (Ostracoda) in the Carboniferous Limestones near Glasgow, and supplied his friends with suites of these little fossils, together with minute Gasteropods; and a tastily mounted set, in a glazed frame, is still preserved in the Hunterian Museum, Lincoln's Inn Fields. Another such set, now in the University Museum, Glasgow, was given to Dr. William Hunter. Four or five of these Ostracoda were figured and described by Ure in his 'History of Rutherglen and East Kilbride,' &c. (8vo, Glasgow, 1793). One of these (pl. 14, fig. 15), a small reniform *Cythere* (?), was found by him abundantly; another (fig. 20), a triangular *Bairdia* (apparently crushed, a condition in which, he says, they are sometimes found), was much scarcer, was obtained at Lawreston and Stuartfield, and in a limestone quarry, fifteen miles west of Newcastle-on-Tyne, near the spot where the Roman wall is intersected by Watling Street. Ure's figs. 16, 17, and 21 are *Beyrichia* and *Kirkbya*: these were the scarcest of all. Among the mounted specimens in the Hunterian Museum are distinguishable—*Cythere*, *Bairdia*, *Kirkbya*, and *Cytherella*;[10] but, as they lie loose and crowded in their little cells, it is difficult to get at their exact features.

Foreign Carboniferous Cytherellæ.

18. Cytherella Benniei, var. Iowensis. Nov. Plate VI, figs. 17 *a*, *b*.

A very strong and large *Cytherella*, with thick, elliptical-oblong valves, compressed anteriorly, and swollen behind. It is much like *C. Benniei*, figs. 3, 4, 5, and 7, and

[1] 'Cat. W.-Scot. Foss.,' 1876, p. 78. [2] Ibid., p. 92. [3] Ibid., p. 77. [4] Ibid., p. 68.
[5] Ibid., p. 68. [6] Ibid., p. 88. [7] Ibid., p. 92. [8] Ibid., p. 82.
[9] Ibid., p. 82. [10] *C. concinna* and *C. scrobiculata* of the present Monograph.

Pl. VII, fig. 12, but its posterior border is more neatly semicircular, and the proportional convexity and compression, as seen in the profile, are not exactly matched in the above-mentioned figures. We look on it as a local and large representative of the same species.

Length 1·16; height ·72; thickness ·56 mm. Proportions 29 : 18 : 14.

It is from the Upper Coal-measures of Iowa, United States of America, and is in Mr. D. Robertson's collection.

19. Cytherella Benniei, var. intermedia. Nov. Plate VII, figs. 7 *a*, *b*.

This subelliptical carapace is simple in outline, and smooth, like many other *Cytherellæ*, and without any very distinctive characters. It comes near *C. Benniei*, though rather weak posteriorly—that is, narrower and more compressed behind than most of its Scotch congeners, and more so also than var. *Iowensis*. Smaller than the last mentioned, it is about as long (though not nearly so stout) as the individuals from Kennoway Den, Fife (Pl. VI, fig. 7). We will call it var. *intermedia*.

Length 1·0; height ·56; thickness ·4 mm. Proportions 25 : 14 : 10.

It is in Mr. D. Robertson's collection, and was got from the Upper Coal-measures of Iowa, U.S.A.

20. Cytherella regularis. Sp. nov. Plate VII, figs. 6 *a*, *b*.

Carapace elliptical in outline; narrow-oval in profile; almost symmetrical in the curves of both dimensions. Smooth; muscle-spot distinct, though faint.

Length ·76; height ·48; thickness ·32 mm. Proportions 19 : 12 : 8.

From the Fusulina-limestone of Iowa. In Mr. John Young's collection.

21. Cytherella regularis, var. ? Plate VII, fig. 9.

This symmetrically ovate carapace-valve, with relatively slight convexity, is from the Carboniferous Formation at Danville, Illinois, U.S.A., and was communicated by Professor McChesney. It may be a small variety of *C. regularis*, above described, from Iowa.

Length ·52; height ·32; thickness ? mm. Proportions 13 : 8 : ?.

22. Cytherella subreniformis. Sp. nov. Plate VI, figs. 18 *a*—*c*.

These suboval, smooth carapace-valves are strikingly like the specimens figured by the late M. J. Bosquet, of Maastricht, from the Chalk of Holland and Belgium, first (1847) as *C. reniformis*, and subsequently (1854) as *C. ovata* (Roemer). The American specimens differ, however, in their less reniform shape and their more central convexity; the profile being lanceolate instead of narrow-ovate. Were these two sets of specimens found together, instead of being widely apart, both geologically and geographically, we should be inclined to regard them as varieties of one species; as it is, we prefer to make the most of their differences, and to call our figured specimens from Iowa *C. subreniformis*, having reference to the fact that the *Cytherella* above-mentioned, referred to *C. ovata* by M. Bosquet in 1854, was at first (in 1847) named by him *C. reniformis*, and being of opinion that it is far better to keep it distinct (as *C. reniformis*, Bosq.) from *C. ovata* (Roemer), with which it does not really agree.

Length 1·4; height ·64; thickness ·48 mm. Proportions 26 : 16 : 12.

C. subreniformis is from the Fusulina-limestone of Iowa, and is in Mr. J. Young's collection.

23. Cytherella concinna ? (page 71). Plate VI, figs. 19 *a*, *b*.

Two carapace-valves (one imperfect), long-oval, almost truly elliptical (as far as the best, fig. 19 *a*, shows), occurred with figs. 18 *a*—*c* in the Carboniferous Limestone (Fusulina) of Iowa. It is hazardous to give this form a specific name without a better set of characters; but it is comparable with *C. concinna*, figs. 9 and 12.

Length 1·28; height ·64; thickness ? mm. Proportions 32 : 16 : ?.

24. Cytherella impressa. Sp. nov. Plate VII, figs. 8 *a*, *b*.

Carapace subelliptical, faintly curved on the dorsal and ventral margins; round in front, subangular behind; smooth. Profile cuneiform, sharp anteriorly, thick posteriorly, and indented on each side by the deep muscle-spot.

Length ·92; height ·48; thickness ? mm. Proportions 23 : 12 : ?.

This differs from the other Iowa specimens, and approaches in form some of the small Scotch varieties of *C. Benniei*, but its posterior margin is too angular for any of them.

This is from the Fusulina-limestone of Iowa, and is in Mr. John Young's collection.

25. Cytherella Richteriana. Sp. nov. Plate VII, figs. 4 *a*—*e*.

These Devonian specimens, from the so-called "Cypridinen-Schiefer" of Saalfeld, were given to us by Prof. Dr. R. Richter some years ago. Pressure may have modified the outlines somewhat, and rendered figs. 4 *a* and 4 *d* more ovate than the oval specimen fig. 4 *c*. The profiles of two different valves give a central convexity. The characteristic flange of the left valve is shown in fig. 4 *e*. Taking them together, as showing probable variations of form in an old and much squeezed rock, we call them *C. Richteriana*, after our well-known friend, the assiduous palæontologist of Saalfeld. They are related apparently to *C. simplex* (Pl. VII, fig. 3), but they have not the ellipticity, nor the relative convexity, of that form. On account of their similarity to *C. simplex* we include these *Devonian* specimens in our Monograph, remembering also that the "Devonian" Fauna and Flora are closely related to those of the "Carboniferous" period.

	mm.	mm.	mm.	mm.	Proportions.			
Length	·96	1·0	1·08	·7	24	25	27	17½.
Height	·7	·68	?	·48	17½	17	?	12.
Thickness	·44	?	·72	?	11	?	18	?

Besides the localities mentioned with the foregoing descriptions of Carboniferous *Cytherellæ* we have noted the following in Scotland as yielding species of simple forms, such as *C. Benniei*, *C. recta*, and *C. simplex*, but not yet determined. In the collection of the Geological Survey of Scotland:—Ponfeigh Burn, near Douglas ('Cat. W.-Scot. Foss.,' p. 77); Climpy Limestone, near Climpy, Wilsontown (ib., p. 92); Mountainblaw, Wilsontown; Hillhead quarry, Wilsontown (ib., p. 74); Limekilns, old quarry adjoining Limekilns House, near East Kilbride, Lanarkshire, from shale between limestones Nos. 1 and 2 of the Calderwood series (ib., p. 80); Whitefield, old quarry, Peeblesshire; and shales of the Calciferous Sandstone series, north of New Castleton, Roxburghshire. In 1871 Mr. John Henderson, of Edinburgh, noticed one or more *Cytherellæ* in the strata on the west side of Craig-Lockhart Hill, three miles south of the village of Currie, Pentland Hills.

ADDENDUM TO THE CYPRIDINADÆ. (See page 43).

2. Philomedes elongata. Sp. nov. Plate VI, figs. 1 *a*, *b*, *c*.

Carapace-valve elongate, depressed; long-oblong; straight dorsal, and rather convex ventral margin, with one end (posterior) elliptically rounded, the anterior truncate and hooked, the straight dorsal margin being produced into a large blunt hook, overhanging a deep open notch, which reaches upwards for about four fifths of the height of the valve. The postero-ventral ellipticity gives the outline the shape of a broad knife-blade. If compressed by embedment in the shale, this carapace may have been subcylindrical originally.

The length, including the hook, is 6 millimètres; the hook is about $\frac{1}{10}$th of the whole length; the greatest height of the valve is $2\frac{1}{2}$ mm.

The surface that remains shows numerous conspicuous radiate markings, analogous to those seen in *Cypridina radiata*, J. and K., p. 14, Pl. V, figs. 6 *d*, *e*; also in some Beyrichian casts, from the Carboniferous strata in Dumfriesshire, which belong to *B. gigantea*, J. and K., Pl. IV, figs. 27, 28. These radiate spots appear to have some relation to the radiate tops of the transverse columns, dividing the blood-canals in the mantle or investment of the test of *Estheria*, as described and illustrated by E. Grube, 'Wiegmann's Archiv für Naturgesch.,' 1865, p. (15) 217, pl. 10, figs. 7 and 11.

This unique specimen was found by Mr. Edward Wilson, F.G.S., of Nottingham, on the pit-bank of the Claycross Company's Colliery at Claycross Station, about five miles south of Chesterfield, Derbyshire. Mr. Wilson observes that "this colliery works the Black Shale or Silkstone Seam, the bed of coal which the Geological Survey places at the base of the Middle Coal-measures, dividing that series from the Lower or Gannister series. There can be little doubt that the specimen came from the *bind* (shaly sandstone) that forms the roof of that (Silkstone) seam. Therefore its horizon is the base of the Middle Coal-measures."

This remarkable Cypridinad, though so narrow and compressed, seems to be nearer in its form to *Philomedes* than to any other of the *Cypridinadæ* (see pp. 4, 8, and 43).

CARBONIFEROUS ENTOMIDIDÆ.

ENTOMIDIDÆ, *Jones*, 1870. Month. Microsc. Journ., vol. iv, p. 187.
— — 1873. Ann. Mag. Nat. Hist., ser. 4, vol. xi, p. 417.

Under the heading ENTOMIDIDÆ two genera, *Entomis* and *Entomidella*, have been grouped on account of their extremely developed nuchal furrow, thus standing apart from the other known Ostracoda, recent and fossil. They differ from those Cypridinads which have a nuchal furrow by the absence of a frontal notch.

In 1870[1] *Entomis* and *Entomidella* were included with the *Cypridinadæ*, but in 1873[2] they were separated off as a distinct group—*Entomididæ*—on account of the intensity of their dorsal sulcus, the absence of frontal sinus and hook, and their more or less *concentric* ornament. It was the apparent similarity of the transverse ridging in *Entomis Koninckiana* and *E. Burrovii* (Plate IV, figs. 20 and 21) to that in some *Cyprellæ*, shown in the same plate, that led to the collocation of these forms on that Plate. The real difference, however, in the ridging (that of *Cyprella* being discontinuous, whereas that of *Entomis* is continued by curvatures on the ventral region) was soon recognised, and these *Entomididæ* have had to remain undescribed until the PLATYCOPA were treated of in their right place.

The *Entomididæ* are more closely related to some members of the *Leperditiadæ*[3] than to any other known genera. Their deep dorsal or nuchal furrow is an exaggeration of that in *Primitia*, *Beyrichia*, and *Kirkbya*. Indeed, there is a faint trace of it in *Leperditia* and *Isochilina*. The plan of concentric ridging is present also in some *Kirkbyæ*. Hence we think that provisionally we may place the *Entomididæ* close to the *Leperditiadæ*. As some good Carboniferous species have been figured in Plate IV we proceed to describe them.

ENTOMIS, *Jones*, 1861.

1841 and 1844 Cypridina (in part), De Koninck, Nouv. Mém. Acad. Roy. Sci. et Belles Lettres de Bruxelles, vol. xiv, 1841, Mém. Crust. foss. Belg., p. 18; Descript. Anim. foss. Carb. Belg., 1844, p. 587.

[1] 'Monthly Microsc. Journ.,' vol. iv, 1870, p. 187.
[2] Ibid., vol. x, 1873, p. 77.
[3] Ibid., vol. iv, p. 187.

1842 Cytherina, G. Sandberger, Neues Jahrb. für Min., &c., Jahrg. 1842, p. 226.
1845 Cypridina, G. Sandberger, Jahrb. Vereins für Nat. Nassau, Heft ii, pp. 121, 123.
1848 — (in part), H. G. Bronn, Index Palæontol., i, p. 387; ii, p. 559.
1848 — Richter, Beitrag zur Paläontol. der Thüringer-Waldes, p. 19.
1850 — G. and Frid. Sandberger, Verst. rhein. Schicht. in Nassau, p. 4.
1852 — Bronn and Roemer, Lethæa Geognost., 3rd edit., vol. i, part ii, p. 531.
1854 — (in part), Pictet, Traité de Paléontol., 2nd edit., vol. ii, p. 535.
1854 — F. A. Roemer, Palæontographica, vol. iii, pp. 19, 28, 42, 111.
1856 — Richter, Beitrag, &c., Denksch. math.-nat. Cl. k. k. Akad. Wien, vol. xi, p. 121.
1861 Entomis, Jones, Mem. Geol. Survey Gt. Brit., Geol. Edinburgh (Explan. Map 32), p. 137.
1863 and 1864 Entomis, Jones and Kirkby, Geologist, vol. vi, 1863, p. 460; Rep. Brit. Assoc. Newcastle-on-Tyne, for 1863, 1864, Trans. Sect., p. 80; Neues Jahrb. f. Min., &c., Jahrg. 1864, p. 54; Canad. Nat. Geol., n. s., vol. i, p. 237.
1866 Cypridina, F. A. Roemer, Verst. Harzgeb., &c., Palæontogr., vol. xiii, Lief. v, pp. 226 and 232.
1868 Entomis, Bigsby, Thesaurus Siluricus, p. 74.
1869 Cypridina, Ludwig, Neues Jahrb. f. Min., &c., Jahrg. 1869, p. 674.
1869 — Richter, Zeitsch. deutsch. geol. Ges., vol. xxi, pp. 390, 391, 757, &c.
1869 and 1870 Entomis, Jones, Palæoz. Brit. Entom. (Geol. Assoc., 1869), pp. 2 and 5; Monthly Microsc. Journ., vol. iv, 1870, pp. 185, 187.
1872 Entomis, Barrande, Crustac. Poiss. Silur. Bohême (Extrait, &c.), p. 41; Système Silur. Bohême, vol. i, Supplément, p. 512.
1873 — Jones, Notes on the Pal. Biv. Entom., x (*Entomis* and *Entomidella*), Ann. Mag. Nat. Hist., ser. 4, vol. xi, p. 413.
1874 Richteria, Jones, Neues Jahrb. f. Min., &c., Jahrg. 1874, p. 180.
1874 Entomis, Jones, Trans. Geol. Soc. Edinburgh, vol. ii, p. 322; Geol. Magaz., decade ii, vol. i, p. 511.
1878 — Gümbel, Kurze Anleit. geol. Beob. Alpen, p. 97.
1878 Cypridina, Entomis, et Richteria, Bigsby, Thesaurus Devonico-Carboniferus, pp. 26, 27, 249.
1879 Entomis, Jones, Pal. Biv. Entom., xiii, Ann. Mag. Nat. Hist., ser. 5, vol. iv, p. 182.
1879 — Jones, Nicholson and Etheridge's Monogr. Silur. Fossils Girvan, fasc. ii, p. 223.

1881 Entomis, Jones, Geolog. Magaz., dec. ii, vol. viii, p. 341.
1883 — Jones, Ann. Mag. Nat. Hist., ser. 5, vol. xii, p. 245.
1884 — J. M. Clarke, Neues Jahrb. f. Min., &c., Jahrg. 1884, i, p. 184.

Entomis has a bivalved, convex carapace, sub-oblong, ovate-oblong, fabiform, amygdaliform, or subreniform; and is more or less constricted dorsally by a transverse furrow across the hinge-line. This impression, beginning on each valve at or in front of the middle, is continued across its surface to the hinge-line, usually with a slight curvature. In front of the sulcus there is sometimes a rounded tubercle; but this is variable in position and shape; sometimes it is a spine, sometimes it is wanting. In *Entomis tuberosa*, a radiate muscle-spot, somewhat like that of *Leperditia*, in connection with the tubercle, is shown on some internal casts in Silurian mudstone from the Pentland Hills, Scotland (Messrs. Haswell and Brown's collections).

The surface of the valves may be either smooth, or ornamented with raised lines or delicate riblets, arranged in a definite pattern,—transverse, longitudinal, or concentric, and sometimes associated with minute spines or prickles.

The anterior margin is not indented with any sinus or notch; and is therefore without beak or hood.

This beakless and transversely sulcate form is, as above stated, of uncertain alliance. It approximates to some of the beaked Cypridinads (*Cyprella* and *Cypridella*) in having a nuchal furrow (which is, however, traceable in many other Palæozoic bivalved Entomostraca) and sometimes a sub-median knob; but the former is usually very strongly marked in *Entomis*, and the latter is very variable. In some species the sculpturing of the valves distantly resembles the annular ornament seen in *Cyprella* (compare figs. 13 and 21, Pl. IV); but usually it is quite distinct.

As far as the shape of the carapace is concerned, *Entomis* stands in the same relation to *Cypridella* and *Cyprella* of De Koninck, as *Polycope* of Sars to *Cypridina* of Milne-Edwards, the anterior notch having disappeared in both *Polycope* and *Entomis*. The animals, however, may have respectively differed very much; for *Polycope* and *Cypridina* belong to different *families*, and the deep nuchal furrow in *Entomis*, far more impressed than in *Cypridella* and *Cyprella*, was probably in direct relation with the structure of its internal organs, under modifications not present in other genera.

The physiological meaning of the nuchal furrow in these Entomostraca is not understood. Among recent forms it is faintly indicated in *Philomedes* and *Halocypris*; it is stronger in *Pleopsis* and *Daphnella*, belonging to quite another group of Entomostraca.

1. Entomis concentrica (*De Koninck*), 1841. Pl. IV, figs. 22, 25*a*, 25*b*.

Cypridina concentrica, *De Koninck*, 1841. Nouv. Mém. Acad. Roy. Brux., vol. xiv, p. 18, fig. 10; 1844, Descript. Anim. foss. Terr. Carb. Belg., p. 587, pl. 52, figs. 4, 5.

Cythere concentrica, *Dupont*, 1863. Bull. Acad. R. Sc. Brux., sér. 2, vol. xv, p. 110.

Entomis — *Jones and Kirkby*, 1864. Neues Jahrb. für Min., &c., Jahrg. 1864, p. 54; Canad. Nat. Geol., n. s., vol. i, p. 237.

This Belgian species has an oblong carapace with rounded ends, like a haricot-bean. The lower margin has an elliptical curvature in Prof. L. De Koninck's fig. 5, but is nearly straight in our fig. 25*a*.

	mm.	mm.	Proportions.	
Length	6·25	5·25	25	21
Height	3·5	3	14	12
Thickness	3	2·5	12	10

Each valve is sculptured with concentric elliptical lines, like the minute plicæ or ridges of the skin on the inside of the human finger-top. These delicate wrinkles, however, are interrupted by the strong transverse sulcus near the middle of the valve, so that the hinder moiety of the surface has a complete and nearly horizontal pattern of elliptically concentric rugæ, and the lowest or most ventral of these curve forward and upward on the anterior moiety of the valve, and converge on its antero-dorsal margin, where the sulcus or nuchal furrow begins.

The specimens here figured were given to us by our friend the late M. J. Bosquet, of Maastricht, well known for his palæontological researches in Holland and Belgium.

Fig. 22 is a cream-coloured carapace; and figs. 25*a*, 25*b*, represent a yellowish-grey internal cast, showing a strong sulcus, and retaining a faint trace of the external ornament. Fig. 22 gives a dorsal view (in outline) of the two valves, opened, but still touching along the hinge-margin.

This species is said to be very rare in Belgium. We have not met with it in Britain.

2. Entomis biconcentrica, *Jones*, 1870. Pl. IV, figs. 23*a*, 23*b*, 26*a*, 26*d*.

Entomis biconcentrica, *Jones*, 1870. Monthly Microsc. Journ. for October, 1870, vol. iv, p. 185, pl. lxi, figs. 13 *a*, *b*.

This is also fabiform, oblong in outline with rounded ends; and it has a strong sulcus, as in *E. concentrica*. Its sculpturing, however, though of the same character,

differs by the posterior elliptical rings of rugæ being less truly horixontal, and by the anterior rugæ, after sloping upwards and outwards halfway up the valve, turning back on themselves towards the sulcus, in the front half of the valve, and thus forming another but smaller, and still more oblique ellipse of concentric lines.

Length 6·25 ; height 3·5 ; thickness 3·5 mm. Proportions 25 : 14 : 14.

Fig. 26, taken from one of the black carapaces found in the Carboniferous Limestone of Little Island, Cork, by Joseph Wright, Esq., F.G.S., shows all the features very clearly, including the rugæ and the coarsely reticulate pitting of the surface of the valves.

E. biconcentrica has also been found in the Carboniferous Limestone Series near Carluke.

The ornament of *E. concentrica*, and especially of *E. biconcentrica*, has some analogy to that of the Silurian *E. migrans* (Barrande, 'Syst. Sil. Bohême,' vol. i, Suppl., pp. 514 and 515, pl. xxiv, figs. 10—14), inasmuch as the last has longitudinal wrinkles or riblets curving along the ventral edge, and turned back on themselves in the upper part of each moiety of the valve. They make, however, two nearly equal concentric triangular patterns (not always regular) instead of elliptical curves. The rugæ also seem to be coarser, and the valves are shorter and rounder, with semicircular ventral, and deeply indented dorsal margin.

Barrande's *E. dimidiata* (op. cit., p. 513) also has traces of somewhat similar but very delicate riblets.

A little thickening on the anterior edge of the sulcus is visible in M. Barrande's figs. 11 and 13, and also in our drawing of *E. Burrovii* (fig. 21); and this may represent the large tubercle in the *Cyprellæ* and *Cypridellæ;* also that in our *Entomis obscura*, in *E. pelagica*, Barr., and *E. tuberosa*, Jones, as well as the spine in *E. aciculata* Jones. The last three are Silurian.

There is a strong resemblance in the ornamentation of the Carboniferous Entomids with that of some of the Devonian species, formerly known as "Cypridinæ" (alluded to also by M. Barrande, op. cit., p. 515). A reference to the 'Annals Nat. Hist.' for September, 1879, p. 187, pl. ii, figs. 11 and 12, will show that the Devonian forms there figured and described as *Entomis gyrata* (Richter) have longitudinal riblets bent sharply on themselves at each extremity, and cut into two by the vertical sulcus so as to leave a concentric group on each moiety of the valve.

3. Entomis Burrovii. Sp. nov. Plate IV, figs. 21 *a*—*c*.

Fig. 21 shows fully the characters and features of a fine *Entomis* from Settle, West Yorkshire. This is a dark-grey left valve, nearly oblong, truncate behind, rounded in

front, and deeply impressed with the dorsal (nuchal) sulcus, slightly in front of the centre. The posterior moiety bears about eleven vertical, somewhat sinuous, parallel riblets, curving forwards along the ventral region, and fading out forwards as they slope upwards over the anterior portion of the valve. The hinder moiety is rather larger than the other.

Length 6·25; height 3·75; thickness 3·5 mm. Proportions 25 : 15 : 14.

This, one of the best of the excellent specimens collected by the late Mr. J. H. Burrow at Settle, we named in 1874 (Explanation of Plate IV) in compliment to him, and we regret that in consequence of his death we have now to regard it only as a memorial of his enthusiastic attachment to geology.

4. Entomis Koninckiana. Sp. nov. Plate IV, figs. 20 *a*—*c*.

This well-marked *Entomis* is oblong, with unequal ends, a deep medial sulcus, and comparatively few but distinct costulæ. There are about six, vertical and parallel on the posterior half, some of which curve along the ventral region, and slope up thence towards the antero-dorsal margin (imperfect in this specimen). The front moiety of the valve is rather more convex than the other.

Length 5·25; height 3; thickness 3 mm. Proportions 21 : 12 : 12.

This is a light-grey valve in the whitish limestone of Settle, West Yorkshire, and as it is well worthy of distinction we dedicate it to our esteemed friend, the eminent and veteran palæontologist, Prof. Dr. L. de Koninck, who first recognised and described many of the Entomostraca of this interesting group in the Carboniferous Limestone of Belgium.

5. Entomis obscura. Sp. nov. Plate IV, figs. 19 *a*—*d*, 24.

Fig. 19 represents a smooth but weathered or partly dissolved valve, grey like its matrix of limestone, from Cork, Ireland. Its surface is not so distinctly reticulate as the figure appears to be. The valve is oblong, rounded anteriorly, and somewhat obliquely truncate behind. It has a submedial dorsal furrow, and a large tubercle on the front half, but the hinder moiety is rather larger and more convex than the other.

Length 6·25; height 3·75; thickness 3·25 mm. Proportions 25 : 15 : 13.

Fig. 24 is drawn from a ferruginous internal cast of a similar *Entomis*, in grey limestone from Settle, West Yorkshire. It is not well preserved, the ventral margin being damaged.

This differs sufficiently from other known forms to be regarded as distinct. On account, however, of its rather feeble characterisation we have termed it *E. obscura*.

NOTES ON Pl. IV, Figs. 27 and 28, and Pl. VII, Figs. 16 and 17.

The above-mentioned figures do not belong to Cypridinads nor Cytherellids, but were introduced into the Plates by inadvertence.

1. The specimens, figs. 27 and 28 (*Beyrichia gigantea*) in Pl. IV, having been found with the *Cypridinads* in the Mountain-limestone at Longnor, in Derbyshire, and at Cork, in Ireland, were sketched in as associates. They are remarkable for their size.

They have the three lobes, marginal rim, and outline of Beyrichian valves. The posterior lobe is the largest (to the right hand in fig. 27, and on the left in fig. 28) as usual. The middle lobe is rather larger (relatively) than in some of the known species of *Beyrichia;* and the three lobes are not so deeply divided by valleys as in many cases.

Fig. 27 shows a somewhat damaged left valve ($\frac{1}{6}$ inch long) in grey Upper-Carboniferous Limestone, from Parkhill, near Longnor, Derbyshire, now in the Museum of the Geological Survey at Jermyn Street, on Tablet $\frac{38}{14}$. Fig. 28 is a larger, but badly preserved right valve, still embedded in the light-grey Limestone of Cork, and collected by Mr. Joseph Wright, F.G.S. Mr. J. R. J. Hunter has found an imperfect cast of *B. gigantea* in the Mainpost Limestone at Braidwood, near Carluke.[1]

The relatively large size gives origin to the name that we have proposed for this species.

	mm.	mm.		Proportions.	
Length	4·2	5·2	.	17	21
Height	3·2	3·5	.	13	14
Thickness	3·	?	.	12	?

Numerous specimens of a similar form, occurring on a black Lower-Carboniferous shale from Eskdale, Dumfriesshire, are in the British Museum. Some have the valves united, but lying open; and in one, at least, a radiated structure of the valves much like that in *Cypridina radiata*, Pl. V, figs. 6 *d*, *e*, *f*, and *Philomedes elongata*, Pl. VI, figs. 1 *a*, *b*, *c*, is clearly indicated. The *radiate* structure of fossil Entomostracan valves is shown also in E. O. Ulrich's *Leperditia radiata*, from the Lower Silurian strata (Utica Slate) near Cincinnati, Ohio, U.S. (see 'Journ. Cincin. Soc. Nat. Hist.,' vol. ii, 1879, p. 2, pl. 7, figs. 2 *a*, *b*. This small form looks like a simple *Primitia*.

2. Pl. VII, figs. 16 *a*, *b*, *c*, represent a form which was at first taken for a *Cytherella;* but the want of dorsal overlap, and the presence of a transverse hollow, shallow as it is, which in other specimens becomes a marked depression and foreshadows the sulcus seen

[1] 'Catal. Western-Scottish Fossils,' 1876, p. 71.

in *B. arcuata* and its congeners, correct the first impression. We leave this passage-form of weak Beyrichian alliance for further observation.

The specimen figured has a length ·88; height ·48; thickness ·4 mm. (proportions 22 : 12 : 10); and is from the Axinus-bed in the Lower Carboniferous of Randerstone, Fifeshire.

3. Pl. VII, figs. 17 *a*, *b*, *c*, was drawn at first as an abnormal *Entomis*, owing to its concentric ornament and central depression; but the latter, more like that in *Kirkbya*, is not equal to the deep transverse sulcus of *Entomis* (see Pl. IV, figs. 20, 21, 26); and the ornament resembles that of *Kirkbya costata*, M'Coy.[1]

The specimen is in length 1·28; height ·68; thickness ·72 mm. (proportions 32 : 17 : 18), and is from Brockley, Lesmahagow, Mr. D. Robertson's Collection.

[1] 'Annals Mag. Nat. Hist.,' ser. 3, vol. xviii, 1866, p. 43.

ERRATA ET CORRIGENDA.

Page 9, line 6 from bottom, *for* 1855, *read* Proceed. Amer. Acad., ii, pp. 51—53, 1852.

„ 11. *Add to Synonyms:*

Cypridina (including some *Cytheræ*, &c.), *Bronn.* Leth. geogn., i, p. 38, Table, 1851.

— (including *Entomis*, &c.), *Bronn.* Leth. geogn., 2nd edit., p. 531, 1852.

„ 12. *Add to Synonyms:* Daphnia ? primæva, *M'Coy.* Ann. Mag. Nat. Hist., 2, iv, p. 395, 1849.

„ 20. Cypridina oblonga, as figured at Pl. V, fig. 12, is probably imperfect at the beak, as shown by a better specimen with a long beak like that of *C. brevimentum.*

„ 23. Cypridinella Bosqueti has been found at Middleton, in the Carboniferous Limestone, near Cork, by Mr. Joseph Wright, F.G.S.

„ 38. *Add to Synonyms:*

Cypridella chrysalidea, *Bronn* (*Römer*). Lethæa geogn., vol. i, part 2, p. 533, t. 9^3, f. 11, 1852.

„ 42, line 15 from bottom, *for* 53, *read* 54.

„ 49. *Add to Synonyms:*

Entomoconchus Scouleri, *Bronn* (*Römer*). Leth. geogn., vol. i, part 2, p. 534, t. 9^3, f. 14, 1852.

— *Jones.* Palæoz. Biv. Entom., Proc. Geol. Assoc., 1869, pp. 2, 5.

„ 53, line 8 from top, *for* F, fig. 2, *read* F, f. 2.

„ 54. Polycope.

In the palæontological portion of "The Yorkshire Lias," by R. Tate and J. F. Blake, 1876, the latter has noted, at page 434, that the Carboniferous species which we have referred to *Polycope* appear to him "to belong to a different family, and only to bear an accidental resemblance to *Polycope* in their simplicity." This resemblance being due possibly to homoplasy and not to homogeny, Prof. Blake suggests (in letter) that it is not advisable to refer these Carboniferous forms to a member of the *Cladocopa* rather than to the *Myodocopa*, of the former of which (excepting Mr. Blake's liassic species) only recent and post-tertiary examples are known. Our friend's suggestion is doubtless well-founded. It may be too bold to suppose that this special section of Ostracods had been already separated off at that early period (Carboniferous), and that a few forms, among a number of others very similar to them, alone represented this section; and perhaps we ought to have kept them among the *Cypridinadæ*, with a distinct name. So many, however, of the fossil bivalve Entomostraca, even of Silurian age, seem to correspond with known recent *genera* of various alliances, that it seems scarcely strange to find some palæozoic members of even a limited and rare section. At all events, we must leave the question open for the present.

Explanation of Plate V. Fig. 6 *d* is magnified 80 diameters.

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PLATE VI.

All the specimens are magnified 25 diameters, except figs. 1 *a*, *b*.

Fig.

1 *a*—*c*. *Cypridina* (*Philomedes*) *elongata*, sp. nov. Clay-cross Colliery, Derbyshire. (Page 81.)
a, Left valve, and *b*, ventral view (without the hook), magnified 5 diameters ; *c*, portion of the surface, magnified 25 diameters.

2 *a*—*c*. *Cytherella valida*, sp. nov. Calees, East Cumberland. (Page 70.)
a, Right valve ; *b*, left valve ; *c*, ventral view.

3 *a*, *b*. *Cytherella Benniei*, sp. nov. Mouse-Water, Lanarkshire. (Page 70.)
a, Left valve ; *b*, ventral view.

4 *a*, *b*. *Cytherella Benniei*, sp. nov. Calderside, Lanarkshire. (Page 70.)
a, Right valve ; *b*, ventral view.

5 *a*, *b*. *Cytherella Benniei*, sp. nov. Calderside, Lanarkshire. (Page 70.)
a, Left valve ; *b*, dorsal view.

6 *a*, *b*. *Cytherella recta*, sp. nov. Auchenbeg Old Quarry, Lanarkshire. (Page 71.)
a, Left valve ; *b*, ventral view.

7 *a*, *b*. *Cytherella Benniei*, sp. nov. Large individual. Kennoway Den, Fifeshire. (Page 70.)

8 *a*, *b*. *Cytherella brevis*, Jones. Campsie, Stirlingshire. (Page 72.)
a, Right valve ; *b*, edge view.

9. *Cytherella concinna*, sp. nov. From David Ure's specimens in the Hunterian Museum, Roy. Coll. Surgeons, London. (Page 71.)

10 *a*—*e*. *Cytherella scrobiculata*, sp. nov. *a*, From David Ure's specimens in the Hunterian Museum, Roy. Coll. Surgeons, London ; *b*, *c*, *d*, and *e*, from Robroyston, Lanarkshire. (Page 76.)
a, Left valve ; *b*, right valve, rather crushed ; *c*, right valve ; *d*, left valve ; *e*, dorsal view.

11 *a*, *b*. *Cytherella recta*, sp. nov. Wilsontown, Lanarkshire. (Page 71.)
a, Left valve ; *b*, dorsal view.

12 *a*, *b*. *Cytherella concinna*, sp. nov. Holwell, Somerset. (Page 71.)
a, Right valve ; *b*, ventral view.

13 *a*, *b*. *Cytherella Hibernica*, sp. nov. Cultra, County Down, Ireland. (Page 72.)
a, Right valve ; *b*, edge view.

14 *a*, *b*. *Cytherella æqualis*, sp. nov. Great Orme Head, North Wales. (Page 74.)
a, Side view ; *b*, dorsal view.

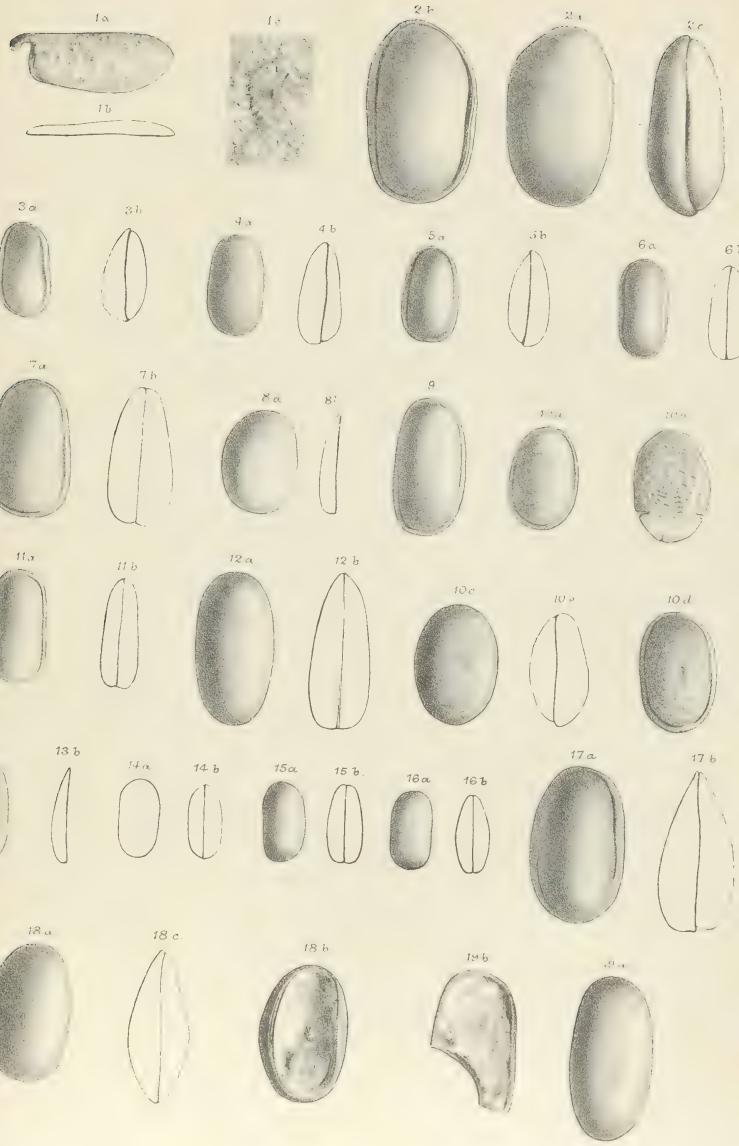
15 *a*, *b*. *Cytherella æqualis*, sp. nov. Gare, Lanarkshire. (Page 74.)
a, Side view ; *b*, dorsal view.

16 *a*, *b*. *Cytherella æqualis*, sp. nov. Gare, Lanarkshire. (Page 74.)
a, Side view ; *b*, dorsal view.

17 *a*, *b*. *Cytherella Benniei*, var. *Iowensis*. Upper Coalmeasures ; Iowa, North America. (Page 77).
a, Left valve ; *b*, ventral view.

18 *a*, *b*, *c*. *Cytherella subreniformis*, sp. nov. Fusulina-limestone ; Iowa, North America. (Page 79.)
a, Left valve ; *b*, right valve, interior ; *c*, ventral view.

19 *a*, *b*. *Cytherella concinna ?* Fusulina-limestone ; Iowa, North America. (Page 79.)



A.B. Woodward lith.

Carboniferous Entomostraca.

West, Newman & Co imp

PLATE VII.

All the specimens are magnified 25 diameters.

Fig.

1 *a*—*c*. *Cytherella Tatei*, Jones. Lamberton, Northumberland. (Page 74.)
a, Right valve; *b*, ventral view; *c*, end view.

2 *a*, *b*. *Cytherella? inflata*, Jones and Kirkby. Craigenglen, Stirlingshire. (Page 74.)
a, Right valve; *b*, end view.

3 *a*, *b*. *Cytherella simplex*, Jones and Kirkby. Raes Gill, Lanarkshire. (Page 75.)
a, Right valve; *b*, edge view.

4 *a*—*e*. *Cytherella Richteriana*, sp. nov. Devonian; Saalfeld, Germany. (Page 80.)
a, *c*, *d*, Right valves; *b*, *e*, edge views.

5 *a*—*d*. *Cytherella obliquata*, G. S. Brady, MS. Capelrig Quarry, Lanarkshire. (Page 73.)
a, Left valve; *b*, ventral view; *c*, dorsal view; *d*, end view.

6 *a*, *b*. *Cytherella regularis*, sp. nov. Fusulina-limestone; Iowa, North America. (Page 78.)
a, Left valve; *b*, ventral view.

7 *a*, *b*. *Cytherella Benniei*, var. *intermedia*. Upper Coalmeasures; Iowa, North America. (Page 78.)
a, Left valve; *b*, dorsal view.

8 *a*, *b*. *Cytherella impressa*, sp. nov. Fusulina-limestone; Iowa, North America.
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9. *Cytherella regularis*, var. ? Danville, Illinois, North America. (Page 78.)

10 *a*, *b*, *c*. *Cytherella? obesa*, sp. nov. West Broadstone, Ayrshire. (Page 75.)
a, Right valve; *b*, dorsal view; *c*, end view.

11. *Cytherella*, sp. indet. Wyebourne, Cumberland. (Page 75.)

12 *a*, *b*, *c*, *d*. *Cytherella Benniei*, sp. nov. Swinehill Colliery, near Lanark. (Page 70.)
a, Left valve; *b*, ventral view; *c*, dorsal view; *d*, end view.

13 *a*, *b*, *c*. *Cytherella*, sp. indet. (near *C. valida*). Carluke, Lanarkshire. (Page 76.)
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14 *a*, *b*, *c*. *Cytherella nuciformis*, Jones. Permian; Sunderland, Durham. (Page 73.)
a, Right valve; *b*, dorsal view; *c*, end view.

15 *a*, *b*, *c*. *Cytherella? rotundata*, sp. nov. Mayfield Quarry, Dalkeith, Midlothian. (Page 76.)
a, *b*, *c*, Outlines of a testiferous specimen.

16 *a*, *b*, *c*. *Beyrichia?* sp. Randerstone, Fife. (Page 88.)
a, Left valve; *b*, ventral view; *c*, dorsal view.

17 *a*, *b*, *c*. *Kirkbya costata?* Brockley, Lanarkshire. (Page 89.)
a, Right valve; *b*, edge view; *c*, end view.

A. B. Woodward lith.

Carboniferous Entomostraca.

West, Newman & Co imp

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TRILOBITES.

BY

HENRY WOODWARD, LL.D., F.R.S., F.G.S., &c.,

KEEPER OF THE DEPARTMENT OF GEOLOGY IN THE BRITISH MUSEUM (NATURAL HISTORY).

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16. Griffithides brevispinus, *H. Woodw., sp. nov.* Pl. VII, figs. 7, 8.

Among the various specimens received from Mr. Robert Craig, of Langside, Beith, Ayrshire, N.B., are two fragments of heads of a small species of Trilobite of the genus *Griffithides*, which, as the discoverer observes, appear to differ from any which have hitherto come under notice from the Carboniferous Limestone. The head is nearly twice as broad as it is long, the free cheek terminating laterally in a short spine; the eye, which is very smooth, is rounder and more tumid than in other species, and the facets, which are discernible with a Browning's platyscopic lens, are very minute, and do not break the smooth hyaline surface of the compound eye.

The glabella is nearly smooth in front, and overhangs the anterior border of the head-shield; the posterior portion of the glabella and the neck-lobe are irregularly tuberculated. The free-cheek is also tuberculated, and has about eight tubercles on each cheek, placed in a semicircle around the compound eyes. The margin of the shield is raised and striated, and has a rather deep and smooth furrrow between the raised border and the inner portion of the free-cheek.

In the style of its ornamentation this form agrees most nearly with *G. longispinus*, Portl., but the head is shorter and broader, and the spines are only one half the length of that species. I have named this species *G. brevispinus*, H. Woodw.

Formation.—From the Lower Carboniferous Limestone.

Locality.—Langside, Beith, Ayrshire.

From the collection of Mr. Robert Craig, of Langside, Beith, Ayrshire, N.B.

17. Griffithides moriceps, *H. Woodw.*, 1883. Pl. VII, figs. 9, 10, 11, 12.

Griffithides moriceps, *H. Woodw.* Geol. Mag., Dec. ii, vol. x, p. 487, pl. xiii, fig. 4, 1883.

Head-shield semicircular, 22 mm. long and 30 mm. broad; glabella elevated, very gibbous and obtuse in front, and twice as wide at the anterior border as at the neck-furrow; basal-lobe small, rounded; surface of glabella and free-cheeks thickly covered with large round granulations; facial suture running very close around the glabella; free-cheeks hatchet-shaped, central part ornamented and raised, bearing the small smooth reniform eyes close to the basal lobe; border of

cheeks deeply furrowed and smooth, with a raised margin having a rounded rim; neck-lobe narrow, smooth, flattened, and separated by a rather strongly marked neck-furrow, which is continued and unites with the furrow surrounding the free-cheeks, forming somewhat blunt angles to the head-shield.

Formation.—Carboniferous Limestone.

Locality.—Settle, Yorkshire.

Only the head of this rather large species is known, but it differs in many respects so markedly from its nearest ally, *G. seminifera*, that I feel justified in making it a distinct species.

The glabella is broad and rather obtuse in front and very narrow behind; the basal lobes are small and drop-shaped; the eyes are very small, placed far back on the cheeks and near the basal lobes; the granulations on the head and cheeks are coarse and closely placed, and suggested the specific name. Along the anterior border of the head these granulations are elongated, and form a close and regular marginal ornamentation (see Pl. VII, fig. 11). There are five specimens (all detached heads) of this species, from the Carboniferous Limestone of Settle, Yorkshire. They are all preserved in the Woodwardian Museum, Cambridge.

18. Griffithides glaber, *H. Woodw., sp. nov.* Pl. IX, figs. 4 *a* and 4 *b*.

I am indebted to Mr. E. T. Newton, F.G.S., Assistant Naturalist to H.M. Geological Survey of Great Britain, for drawing my attention to this new and interesting form of Carboniferous Trilobite, which I had not observed in the collection on my former visits to the Museum of Practical Geology, Jermyn Street.

Both the specimens figured are preserved in a dark crystalline rock from the Carboniferous Limestone, Castle-Mumbles, Glamorganshire. The extreme length of the more complete specimen (fig. 4 *a*) is 36 mm., and its greatest breadth 13 mm. Length of glabella, including neck-lobe, 12 mm.; length of pygidium 13 mm. The head is much mutilated, but sufficient of it remains to show that the glabella was smooth, rather tumid, longer than wide, with a basal-lobe on each side near the neck; neck-lobe moderately broad, and marked with one central tubercle; the eyes are not preserved; border of free-cheek terminating in a short lateral spine on each side, and striated below. Free thoracic somites nine in number; extremities of pleuræ smooth and truncated; axis rather wider than lateral portion of somite; coalesced abdominal somites about nine in number; axis nearly smooth, with a slightly serrated posterior edge to each body-ring,

margin smooth, rather broad; the pygidium is somewhat narrower and more elongated than in the other Carboniferous species.

Five specimens of pygidia referable to this species are preserved in the Museum of Practical Geology, from the Carboniferous Limestone of Northumberland, and a sixth specimen, in the same collection, from the Upper Carboniferous Shale of Ashford, Derbyshire.

This species in general form agrees most nearly with *G. longispinus*, Portl. (see *ante*, p. 36, Pl. VII, figs. 5 *a*, *b*, *c*, and 6), but *G. glaber*, as its name implies, is smooth or nearly so, whereas *G. longispinus* is coarsely tuberculated both on the head and body segments, the tail alone being smooth.

In *G. glaber* there is a trace of minute serration seen on a pygidium from Ashford, Derbyshire, not discernible on the other specimens, but I consider that they all belong to one and the same species.

Formation.—Carboniferous Limestone.

Localities.—Castle-Mumbles, Glamorganshire; Northumberland; and Ashford, Derbyshire.

All the above specimens are preserved in the Museum of Practical Geology, Jermyn Street.

19. Griffithides? Carringtonensis, *Eth.*, MS. Pl. IX, figs. 6 *a* and *b*.

This species, named by Mr. Etheridge, F.R.S., in manuscript, is represented by two pygidia in the collection of the Museum of Practical Geology, Jermyn Street, and one in British Museum series.

Head-shield and thorax unknown. *Abdomen* or *Pygidium.*—The largest specimen (which is preserved in the British Museum) measures 17 mm. in breadth and 15 mm. in length; the axis is 7 mm. broad at its proximal end, diminishing to $3\frac{1}{2}$ mm. at the distal extremity. It terminates at a distance of 3 mm. from the posterior border, which is smooth, and continues so around the semicircular margin of the pygidium. Twelve coalesced somites are indicated by as many broad and flattened rings in the axis, which have a faint vertical line crossing them on each side of the axis and parallel to the axal furrows. The pleuræ, nine in number, terminate abruptly about 3 mm. from the margin, and are each divided by a median groove.

The other and smaller specimens are fig. 6 *a*, measuring 10 mm. wide by 7 mm. long, and fig. 6 *b* 11 mm. wide by 8 mm. long.

This species agrees most nearly with *G. obsoletus*, but the latter has no distinct margin to the pygidium, and has only ten axal rings.

Formation.—In white crystalline Carboniferous Limestone.

Localities.—Falls Brew, Caldbeck, Cumberland (Mus. Brit.). Fig. 6 *a*, Longnor, Derbyshire, and fig. 6 *b*, from Narrowdale. (Mus. Pract. Geol.)

Note on Griffithides longispinus, *Portlock*, Pl. IX, fig. 3. (See *ante*, p. 36.)

The specimen figured on Pl. IX, fig. 3, represents a detached glabella of this species, with a hypostome lying close to its posterior border. The glabella is also of interest because it exhibits (as a cast in relief), on the side of the decorticated head, the cast of the preocular pore (*p*), so well seen in *Griffithides globiceps* and *Ph. Eichwaldi* (Pl. IV, fig. 6, 8, 10, and 15).

Hypostome.—The anterior border of the hypostome measures 7 mm. in width, and it is also 7 mm. long. The posterior border is narrow and pointed. The middle of the hypostome is very strongly curved; the surface, where preserved, shows it to have been ornamented with delicate branching and wavy raised lines or striæ. Two muscular impressions or indentations mark the hypostome near the narrow extremity. The margin of the hypostome appears to have been thickened.

Formation.—Carboniferous Limestone.

Locality.—Longnor, Derbyshire.

Original specimen in the Museum of Practical Geology, Jermyn Street.

*** The following three species, referred to the genus *Phillipsia*, have been recognised since pp. 11—27 were in print, and require description.

20. Phillipsia laticaudata, *H. Woodw., sp. nov.* Pl. VII, fig. 4.

Head imperfect; glabella tumid, rounded in front, with a narrow, smooth, raised marginal rim; general surface smooth, but finely punctated under a lens; basal lobe separated by a deep semicircular furrow from the rest of the glabella, and with two short lateral furrows on each side. Neck-furrow deep; neck-lobe rounded with one prominent tubercle on the centre. Length of glabella 5 mm., breadth $3\frac{1}{2}$ mm., cheeks not preserved.

Free thoracic segments unknown. Pygidium much broader than long, very strongly trilobed; axis elevated, consisting of twelve coalesced somites; each ring very strongly ridged, and each ridge ornamented with a line of minute tubercles; side pleuræ nine in number, rather broad for half their length, and minutely ornamented, but becoming fainter for the latter half, and dying away near the margin, which is almost smooth. Length of pygidium 6 mm., of axis 5 mm., breadth of tail 9 mm., breadth of axis 4 mm.

Formation.—Carboniferous Limestone.

Locality.—Bolland, Yorkshire.

There are four examples of this small species in black Carboniferous Limestone from Bolland, part of the Gilbertson collection preserved in the British Museum (Natural History). Each specimen of a pygidium has also a detached glabella preserved together in the same piece of matrix. There seems no doubt that the heads and tails originally belonged to the same individuals. They are quite unlike the ornamented pygidia of other species of *Phillipsia*, being broader and shorter, and more delicately ornamented, the pleuræ of the tail in particular being very peculiarly marked in their decoration and form, and in the break in their character midway. They appear to be worthy of specific recognition.

21. Phillipsia scabra, *H. Woodw., sp. nov.* Pl. IX, figs. 5 *a*, *b*.

This species is based upon a head-shield and two pygidia from the Carboniferous Limestone, Vallis Vale, Frome, Somerset, preserved in the Museum of Practical Geology, Jermyn Street.

These are the first remains of Trilobites I have received from the Carboniferous Limestone of the south-west of England.[1]

The head-shield is 12 mm. in breadth by 8 mm. long. The glabella is prominent, rounded in front, but not overhanging the raised anterior border of the cephalon; three oblique furrows mark the sides of the glabella, the front furrow being nearly in a line with the anterior angle of the eye; the basal lobe is large, obtusely triangular in form; neck-lobe 1 mm. deep, divided by a shallow furrow from the glabella; pleuræ of neck-lobe extending for three-fourths the breadth of free-cheeks, and terminating acutely along their posterior margin; lateral border of glabella narrow, but expanding into a moderately broad margin in

[1] Mr. R. H. Valpy, F.G.S., Enborne Lodge, Newbury, informs me that he discovered a bed of shale of Carboniferous age with Trilobites in an excavation made for the Rifle-butts on the top of Black Down, on the Mendip Hills, Somersetshire. They were associated with Entomostraca.

front of the glabella. Free-cheeks small, with a broad and very distinct margin separated by a deep furrow; the margin is striated longitudinally; the head and cheeks are scabrous, most strongly so on the posterior half of the glabella. The eyes were large, nearly 3 mm. in length; they are unfortunately wanting, being represented by the cavity only.

Thoracic segments unknown; probably nine in number.

Pygidium.—The coalesced series of abdominal segments forming the pygidium are about fifteen in number, measuring $8\frac{1}{2}$ mm. long by 10 mm. in breadth. The axis of the tail is broad at the proximal end, and roundly elevated; it decreases in size somewhat rapidly towards the posterior border which it overlaps. The margin of the pygidium is smooth for the breadth of one millimètre.

Formation.—In light reddish-brown coloured shale of Carboniferous age.

Locality.—Vallis Vale, Frome, Somerset.

Phillipsia scabra approaches most nearly to *Ph. gemmulifera* in general appearance, but in the latter species the glabella is smooth, and has only two oblique furrows on its sides; the neck furrow is smooth in *P. gemmulifera*, but finely tuberculated in *P. scabra.*

The pygidium in both species shows a smooth margin, which is widest in *P. scabra.*

The only specimens I have seen of this species are in the Museum of Practical Geology.

22. Phillipsia carinata, *Salter*, MS. Plate IX, fig. 7.

This species, named in MS. by the late Mr. Salter, is represented by two pygidia in the collection of the Museum of Practical Geology, Jermyn Street.

It owes its trivial name to the fact that the axis of the tail is acutely ridged, not roundly arched as in most of the other species. At first sight this might be supposed to be the result of crushing, but a closer examination shows that this is not the case, both specimens being similarly ridged.

The specimen figured (Pl. IX, fig. 7) measures 12 mm. broad by $9\frac{1}{2}$ mm. in length, breadth of axis at the proximal border 5 mm., at the distal extremity 2 mm., length of axis $8\frac{1}{2}$ mm. There are seventeen coalesced rings in the axis, and ten pleuræ on each side. Most of the surface has been decorticated, but where the shelly crust is preserved we see that each ring is ornamented by a single row of small tubercles placed rather far apart.

In Portlock's Geology of Londonderry and Tyrone, on pl. xi, fig. 10, there is

a pygidium figured which seems to have been intended for a caudal shield of this very species; but the author makes no allusion to the figure in his text, nor yet in the explanation to the plate.

Formation.—Carboniferous Limestone.

Locality.—Derbyshire.

This species most nearly resembles the pygidium of *Ph. truncatula*, Phil. sp., but the acutely-ridged character of the axis in *P. carinata* suffices to distinguish it from this and other species.

Note on the Synonymy of Phillipsia gemmulifera, *Phillips, sp.*, 1836. (See *ante*, p. 17.)

Although the Carboniferous Trilobites are but few in number, and are all included in four genera, they have not escaped the usual trouble arising from incorrect determinations.

One of these occurred in reference to *Phillipsia gemmulifera*, Phillips, sp., better known by the name of "*Phillipsia pustulata*," Schlotheim, sp., a name applied to this form by Professor de Koninck in 1842-44 (see 'Descr. Anim. Foss. Terr. Carbonif. de Belgique,' p. 603, tab. liii, fig. 5).

This Trilobite, first known by a pygidiun only, was very carefully figured in Brongniart's and Desmarest's 'Histoire Naturelle des Crust. Foss.,' 1822, pl. iv, fig. 12, p. 145, where it is called "*Asaphus*" from the Black Limestone in the environs of Dublin.

It was next figured by Phillips in his 'Geology of Yorkshire,' 1836, vol. ii, pl. xxii, fig. 11, p. 240, who named it *Asaphus gemmuliferus*.

Buckland again repeated the figure later in the same year, and followed Phillips' name of *A. gemmuliferus*.

Professor de Koninck, in 1842-44, changed the name to *Phillipsia pustulata*, quoting Schlotheim's 'Nachtrage zur Petrefactenkünde' (ii Abth., pp. 42-3, Gotha, 1823, and 'Atlas,' p. 22, and plate xxii, fig. 6) as his authority. Now, as Schlotheim's Trilobite differs very greatly from Phillips's figure, and also from those given by Brongniart and by Buckland, and as, moreover, Schlotheim's specimen was said to have been derived from the youngest Upper Transitional Limestone (Devonian) of the Eifel, I felt great doubt in accepting Professor de Koninck's correlation of *Phillipsia gemmulifera* with *Trilobites pustulatus* of Schlotheim.

These doubts I expressed in a previous part of this Monograph (see pp. 17—19,

Pl. III, figs. 1—8), and also in the 'Geological Magazine' (Decade ii, vol. x, p. 450), and acting on the evidence of the age (Devonian), and the published figure of Schlotheim's specimen, I restored Phillips's specific name of *gemmulifera* for this Carboniferous Limestone form, and discarded that of Schlotheim (*T. pustulatus*) as untenable. Having lately seen and consulted my friend Prof. Dr. Ferdinand Roemer, of the Mineralogischen Museum, Breslau, our highest authority on the fossils of the Eifel, he very kindly promised me, on his return journey, in passing through Berlin to Breslau, to compare my figure of *Phillipsia gemmulifera* with Schlotheim's specimen of *Trilobites pustulatus* in the Berlin Museum. I now have the pleasure to append his letter, which entirely sets the matter at rest.

"*Mineralogical Museum of the*
"*Royal University of Breslau.*

"Dear Dr. Woodward,

"Schlotheim's *Trilobites pustulatus* is nothing else than a pygidium of *Phacops latifrons* from the Eifel. This is proved beyond any doubt by Schlotheim's original specimen in the Berlin Museum.

"Yours very truly,
"Ferd. Roemer."

"17th October, 1883."

Genus 3.—Brachymetopus, *M'Coy*, 1847.

General form elliptical; head-shield semicircular and slightly pointed, about one third wider than long; glabella small, somewhat elevated, one third the width of the entire shield and about one half the length, having a basal lobe on each side, but no short lateral furrows on the glabella; neck-furrow distinctly marked, equal in width to the posterior border of free cheeks; eyes small, smooth, equal to half the length of the glabella; no facial suture visible, only the axal-furrow surrounding the glabella and the neck-furrow; free-cheeks slightly convex, nearly twice as long as they are broad, with no visible suture separating them from one another in front of the glabella, margin broad and slightly grooved, angles of cheeks produced posteriorly into spines. The entire surface of the head covered irregularly with a small bead-like ornamentation.

Thoracic segments not known, probably nine in number.

Pygidium consisting of a variable number of segments, from ten to seventeen according to the species, the axis tapering rapidly to a bluntly-rounded extremity, each segment of axis ornamented with bead-like granulations, ribs with a double furrow extending nearly to the border which is smooth and rounded.

The first specimen of this genus was obtained by Mr. Frederick M'Coy, from the Carboniferous Limestone of Kildare and transmitted to Portlock, who, whilst struck by its dissimilarity to other Mountain Limestone forms, with which he was familiar, placed it provisionally in the genus *Phillipsia*, and described it as *Phillipsia Maccoyi* (see his 'Geology of Londonderry,' &c., 1843, p. 309, pl. xi, fig. 6).

It was left to Prof. M'Coy, in 1847, to propose a new genus for this and two other species, one of which is from Australia.

We append Prof. M'Coy's original description of the genus, from the 'Annals and Magazine of Natural History,' 1847, vol. xx, p. 230.

"*Brachymetopus* (M'Coy), new genus, 1847 (Etym. βραχύς, short, and μέτωπον, *the forehead or glabella*).

"*Gen. Char.*—Cephalothorax truncato-orbicular; limb (free-cheek) narrow, produced backwards into flattened spines; glabella smooth, cylindrical or ovate, about twice as long as wide, not reaching within about its own diameter of the front margin; one pair of small, basal, cephalothoracic furrows, or none. Eyes reniform, in the midst of the cheek (? smooth); eye-line unknown. Surface strongly granulated; one tubercle on each side of the anterior end of the glabella, the marginal row and a circle round each eye being larger than the rest. Body-segments unknown. Pygidium nearly resembling the cephalothorax in size and form, rather more pointed, strongly trilobed, and with a thickened prominent margin; axal lobe about as wide as the lateral lobes, of about seventeen narrow segments; lateral segments about seven, divided from their origin, each terminating in a large tubercle at the margin.

"The minute Trilobites for which I propose the present genus are very distinct in habit from those of other genera, and as two or three species are now known, it seems desirable to place them together under one name. They are the smallest perfect Trilobites known, from two to three lines being the greatest width they have been seen to attain. *Phillipsia Maccoyi* of Captain Portlock's 'Geol. Report on Londonderry,' &c., certainly belongs to this genus, and is at first sight difficult to distinguish specifically from the Australian species. The Irish species alluded to was collected by the writer from the Lower Carboniferous Limestone of Kildare, and sent to Captain Portlock for his 'Monograph of Irish Trilobites,' under the impression that it formed the type of a new genus and species, but probably from there being but one specimen it was placed provisionally by that author in his genus *Phillipsia*, from which it differs in its small, short glabella, smooth eyes,

want of cephalothoracic furrows, &c. Having now examined numerous specimens of the Australian species, there can be no longer any doubt of the distinctness of the group from *Phillipsia* from the characters of the cephalothorax, and the pygidium is still more distinct. From those materials I have therefore drawn up the above characters, which it is believed will distinguish them easily from the other generic types. From the general similarity in the structure of the pygidium, I am inclined to refer the fossil which I have named *Phillipsia* (?) *discors* ('Synopsis of the Carb. Limestone Foss. of Ireland,' pl. 4, fig. 7, p. 161) to the same genus. This is also a very small Trilobite, the length of the pygidium being only three lines; and although referring it provisionally to *Phillipsia*, I suggested in the above work that it should, when better known, form the type of a distinct genus, which, however, it was not possible to frame until now."

23. Brachymetopus ouralicus, *De Vern*, sp. 1845. Pl. VIII, figs. 1—8.

Phillipsia Jonesii, *De Koninck*. Anim. Foss., p. 606, t. 53, fig. 6, 1844 (*non* Portlock).
— ouralica, *De Verneuil*. Geol. Russ., vol. ii, p. 378, tab. 27, figs. 16 *a*, *b*, 1845.
Brachymetopus ouralicus, *Morris*. Cat. Brit. Foss., p. 101, 1854.
— — *J. W. Salter & H. Woodw.* Cat. and Chart Foss. Crust., p. 16, fig. 118, 1865.
— — ? *V. von Möller*. Bull. Soc. Nat. Moscou, pp. 24—27, and pp. 67, 68, pl. ii, figs. 32—35, 1867.
— — *H. Woodw.* Cat. Brit. Foss. Crust., p. 28, 1877.
— — *H. Woodw.* Geol. Mag., Decade ii, vol. x, p. 534, pl. xiii, fig. 1, 1883.

Head-shield nearly twice as broad as it is long, slightly pointed in front; glabella small, tumid; very obtusely conical, only half the length of the head-shield, and one third its breadth, no short lateral furrows visible, only the two small basal lobes which truncate the posterior angles of the glabella; axal-furrow enclosing the glabella antero-laterally; neck-lobe narrow, rounded distinctly, separated by the neck-furrow from the glabella; eyes small, placed close to the glabella, prominent, reniform, surface smooth; no facial suture visible; free-cheeks convex confluent around the glabella, with a broad, flattened, slightly concave margin, the rim of which is slightly raised; posterior margin of free-cheeks separated by a furrow, continuous with the neck-furrow; the posterior angles of

the head produced into short, slightly recurved spines; entire surface of head covered with small bead-like tubercles, five larger ones being placed around the front border of the glabella and one in advance of each eye on the free-cheeks.

Thorax not known.

Pygidium circular, one fourth wider than long, consisting of seventeen coalesced somites, the axis forming one third the entire breadth of the shield where it joins the thorax, but diminishing rapidly to a rather blunt extremity at about one fifth of its length from the margin of the tail-shield which encircles it; each ring of the axis ornamented by a row of small granular tubercles (somewhat irregular in size); about eight grooved pleuræ are seen on each side the axis, each pleura forming a raised rib, extending to and becoming wider at its rounded extremity near the border, marked by a row of small tubercles, and having a shorter intermediate rib, similarly ornamented, placed behind it in the furrow; the pleuræ, as well as the axis of the pygidium, are convex; the margin has a slight narrow rim around it.

Formation.—Carboniferous Limestone.

Locality.—Settle, Yorkshire; Caldbeck, Cumberland; Castleton, Derbyshire; Little Island and Blackrock, Cork; Ardshanbally, Limerick.

Many specimens of this species have been examined from the British Museum (Natural History), the Woodwardian Museum, Cambridge, the Museum of the Geological Survey of Ireland, and from the collections of the Rev. E. O. de la Hey, Cheshire, and Mr. Joseph Wright, F.G.S., of Belfast.

Subjoined is de Vernueil's original description of a pygidium of a Trilobite from the Carboniferous Limestone of Cosatchi-Datchi, East of the Urals ('Geol. Russia' (vol. ii, Palæontology, p. 378, tab. 27, fig. 16 *a*, *b*), and named by him *Phillipsia ouralica* (1845).

"Abdomen semielliptical in form and arched, median lobe produced, narrow, subtriangular, and composed of fourteen articulations of which only ten are visible, the four last being very small and compressed. The lateral lobes are larger than the median lobe, and surrounded by a straight granulated border. The nine pleuræ composing the tail are divided by a groove into two unequal parts, the narrower being ornamented by fine granulations, whilst the larger half bears tubercles twice as large. The median lobe is not prolonged to the posterior border, but is separated by a smooth and rounded border which divides the two series of lateral pleuræ.

"*Dimensions.*—Length 10 millimètres, breadth 12 mm. The breadth would be more considerable if the form of the abdomen was less arched. Median lobe 4 mm., lateral lobe 5 mm.

"*Affinities and differences.*—By the subdivisions of the lateral articulations, this species, of which the abdomen only is known, is easily recognised. It cannot be considered equivalent to *P. Jonesii*, of Portlock, although it has much resemblance. Nevertheless, if we consult De Koninck's figure of this species we see that it differs

from it in the number of lateral articulations, which are from eleven to twelve, instead of nine. Secondly, by the mode of their double furrow which gives rise to ribs of unequal length, and also because these articulations are nearly united behind the median lobe, and not separated by a broad obtuse palette as in our species."

A pygidium of this species was first observed in 1844 by Prof. de Koninck in Belgium, but he erroneously referred it to *Ph. Jonesii*, of Portlock, which is a true *Phillipsia*, and has since been placed as a synonym under *P. derbiensis*. A second pygidium was next observed in the Carboniferous Limestone of Russia by M. de Verneuil, who named it, in 1845, *P. uralica*, M'Coy, having in 1847 established the genus *Brachymetopus* for certain other closely similar forms. Prof. Morris, in 1854, placed both de Koninck's *P. Jonesii* and De Verneuil's *P. uralica* together under *Brachymetopus*, giving de Verneuil's name the priority (the name *Jonesii* being a synonym of *P. derbiensis*, and therefore disqualified for use). I cannot ascertain certainly whether Sir R. I. Murchison published the 1854 edition of 'Siluria' *prior* to the second edition of Morris's Catalogue (1854) or not, but at p. 283 Murchison gives on his woodcut of Fossils (56) fig. 1, a head-shield of a Carboniferous Limestone Trilobite, named *Brachymetopus uralicus*. Morris no doubt obtained his knowledge of the occurrence of this species in England from Salter, whom he quotes as his authority (at p. 101, op. cit.) C. L. Derbyshire (*Salter*). Murchison's woodcut, although very small, is, however, more like the head-shield of *B. Maccoyi*, having the cheek-spines more prolonged than is observed in *B. uralicus*.

In Salter's and Woodward's 'Chart of Fossil Crustacea' (1865) Mr. Salter figured a head-shield under the name of *B. uralicus*, in which no cheek-spines are shown at all. This was probably reproduced from a damaged specimen, as *B. uralicus* always seems to have very short cheek-spines.

In 1867 Valerian von Möller figured a head of *Brachymetopus*, from the Ural Mountains, which he placed under *B. uralicus* with a note of interrogation, and he makes the following observations upon it (op. cit., p. 27).

"*Brachymetopus uralicus* was first described by De Verneuil as *Phillipsia uralica* in the year 1845, but De Verneuil knew only the tail-shield. A few years later a cephalothorax was found in the Carboniferous Limestone of Derbyshire, which showed by its head decoration that it was so nearly related to De Verneuil's species that English palæontologists did not hesitate to identify it with that species. On the other hand, the English specimen shows in the principal features a marked resemblance to *P. Maccoyi*, Portl., so that no doubt now remains as to its connection with *Brachymetopus*. Under this generic name the fossils of our own country were first made known in Morris's 'Catalogue of British Fossils,' and later in Murchison's 'Siluria' (both in 1854). The result of the last year's researches decides me still more in the conclusion that the specimen from Derbyshire quite differs from the typical Uralian form, and therefore belongs to

some other species; my reasons for this I will find an opportunity to give more fully."

At p. 67 he observes: "The cephalothorax under consideration is distinguished from the other species of *Brachymetopus* by the rounded cheek-plates, the wide front, and by the smooth rounded border, and by a different distribution of the bead-like ornamentation of the surface. I believe this specimen belongs to the same species as the pygidium, which has been described as *Phillipsia ouralica* by De Verneuil; at all events, both offer a great similarity in the ornamentation of the surface. If time should prove that my idea is correct then the cephalothorax from the Carboniferous Limestone of Derbyshire, figured in Murchison's 'Siluria' as *Brachymetopus ouralicus*, belongs to a separate species. It differs from the Ural specimens in the pointed cheek-spines, the remarkably small glabella, and the conspicuously small eyes.

In the last-mentioned characters the cephalothorax from Derbyshire differs from all other *Brachymetopi*, and I think therefore that it belongs to the already mentioned tail called *Phillipsia Jonesii* of De Koninck. In Morris's 'Catalogue of British Fossils,' 1854, p. 101, we find these Belgian specimens united with *B. ouralicus*, but they differ from it in the club-shaped widened form of the tail-segments, and the irregularity of the arrangement of the tubercles upon their surface."

It will readily be seen how the difficulty which von Möller experienced arose, when we bear in mind the fact that de Verneuil's *Phillipsia* (*Br.*) *ouralica* was established upon a pygidium only; and de Koninck's *Phillipsia* (*Br.*) *Jonesii*, upon a similar tail from Belgium. M'Coy, who established the genus *Brachymelopus*, did so upon the head and tail of another species, and makes no mention of either the Russian or Belgian specimens.

I think we are justified in concluding (*a*) that the small head-shield figured by Salter in Murchison's 'Siluria' (1854) as *B. ouralicus* (p. 283, fig. 1, Fossils 56) is most probably *B. Maccoyi*; (*b*) that the figure in Salter's and Woodward's chart of Fossil Crustacea (fig. 118, 1865) destitute of cheek-spines is a badly drawn or imperfect shield of *B. ouralicus*; (*c*) that von Möller's figure of a head-shield of *B. ouralicus* (?) is either quite a distinct species, *without cheek-spines*, and more highly ornamented, or that the Russian artist in Moscow who prepared the plate may have embellished it a little more than the specimen perhaps warranted, in placing the large tubercle on the centre of the glabella, in omitting the basal lobes on the glabella, and giving the angles of the cheeks a rounded contour. This last-named feature may be due to the fact that the cheek-spines were not preserved; of course, there may have been two forms, one with cheek-spines, and one without.

I think for the present, however, we may safely retain the name *ouralicus* for

those English specimens which agree in having a pygidium like that figured by de Verneuil associated with a head-shield like those on our Pl. VIII, figs. 1, 2, 3, 4, and 5. Should, however, fuller information be obtained rendering it necessary to separate the Russian species, these must of course retain the original name of *ouralicus*, and for this English form I would then propose that the name *ornatus* should be adopted.

24. Brachymetopus Maccoyi, *Portlock*, sp., 1843. Pl. VIII, figs. 9—13.

Phillipsia Maccoyi, *Portlock*. Geol. Rep. Londond., p. 309, t. 11, fig. 6, 1843.
Brachymetopus Maccoyi, *M'Coy*. Ann. and Mag. Nat. Hist., vol. xx, p. 230, 1847.
— — *Morris*. Cat. Brit. Foss., p. 101, 1854.
— — *H. Woodw.* Cat. Brit. Foss. Crust., p. 27, 1877.
— — *H. Woodw.* Geol. Mag., Decade ii, vol. x, p. 535, pl. xiii, fig. 2, 1883.

Carapace not quite twice as broad as it is long, rather pointed in front; surface sparsely covered with small tubercles; base of the glabella equalling one third the breadth of carapace, and one half the length of shield (without the neck-lobe); basal lobes small, distinct; no facial suture visible; eyes large, placed on the highest point of cheeks, and wider apart than the base of the glabella; rim of the head-shield ornamented by a single row of tubercles, margin strongly grooved or channelled, outer rim slightly raised; posterior border of cheeks marked by a distinct margin equal in width to the neck-lobe, and separated by a groove corresponding to the neck-furrow; latero-posterior angles produced into spines; thoracic somites not known (probably nine in number). Axis of pygidium composed of fifteen coalesced somites, tapering to an obtuse extremity; each somite having about five small tubercles on the axis, and about as many on the eight simple lateral lobes; ribs ending abruptly near the margin of pygidium.

Formation.—Carboniferous Limestone.

Localities.—Ballysteen and Monaster, Ireland.

B. Maccoyi approaches very closely to the preceding species (*B. ouralicus*), but differs in its smaller size, in the more marked and raised rim of the anterior border to the head-shield, in the less highly ornamented surface of the carapace, in which the eyes are larger in proportion and placed wider apart, and the angles of the cheeks are produced into spines which probably reached to the sixth free segment of the thorax. The thorax is unknown. The pygidium is detached, but occurs in the same matrix and from the same locality as the head-shield, and there

seems no reason to doubt their relation to each other. The side-ribs of the pygidium of *B. Maccoyi* differ from those of *B. ouralicus* in being simple, whereas in the latter they are grooved, and each appears like a double rib.

This species has only been met with in Ireland. Our figures are drawn from specimens in the collections of Joseph Wright, Esq., F.G.S., of Belfast, and the Geological Survey of Ireland, Dublin.

Subjoined we give Portlock's original description of *Phillipsia* (*Brachymetopus*) *Maccoyi*, Portlock, *sp.*, 1843.—"Of this minute but very beautiful species the cephalothorax alone has as yet been discovered. It is placed provisionally in this genus (*Phillipsia*), though, from its diminutive size some of the characters of the genus cannot with certainty be exhibited, such for example, as the furrows of the glabella or the reticulation of the eyes. Cephalothorax elevated; general form oval, approaching to semicircular; length ·17″, breadth ·25″; glabella very small, in length rather more than two thirds of the length, and in breadth one fourth of the total breadth of the cephalothorax; the eyes apparently smooth, lunate, and equal in length to two thirds of the height of the glabella; the cheeks are large, slightly convex, separated from the margin by a furrow which joins the neck furrow, and is continuous, passing in front round the glabella. Margin or wings (free-cheeks) elevated, and ending at the posterior angles in prolonged points; the whole surface is covered with granulations, which are arranged along the ridge of the margin and the supra-palpebral line of the eyes like beads." ('Geol. Londonderry,' p. 309.)

Prof. M'Coy, in his 'Synopsis of Carboniferous Fossils of Ireland,' p. 162, refers to this species as follows:

"The only specimen which has occurred of this species I collected myself from the Carboniferous Limestone of Kildare; it was lent to Captain Portlock for his 'Monograph of Irish Trilobites,' as I conceive it to be not only a new species, but the type of a new genus. I am still inclined to think it cannot be ranked with any known genus; the very small size of the glabella, and large size of the eyes, distinguish it from the most nearly allied, and from *Phillipsia*, with which Captain Portlock has ranked it; it is distinguished by the want of the cephalothoracic furrows. As I have, however, no means of examining the specimen now, I cannot characterise it. Length of cephalothorax two lines, width three lines."

25. Brachymetopus discors, *M'Coy*, sp., 1844. Pl. VIII, fig. 15.

Phillipsia (?) discors,	*M'Coy*.	Synop. Carb. Foss. Irel., p. 161, t. 4, fig. 7, 1844.
Brachymetopus discors,	*M'Coy*.	Ann. and Mag. Nat. Hist., vol. xx, p. 230, 1847.
—	— *Morris*.	Cat. Brit. Foss., p. 101, 1854.
—	— *Salter & H. Woodw.*	Cat. and Chart Foss. Crust., p. 16, fig. 120, 1865.
—	— *H. Woodw.*	Cat. Brit. Foss. Crust., p. 27, 1877.
—	— *H. Woodw.*	Geol. Mag., Decade ii, vol. x. p. 536, 1883.

This species is founded on a pygidium only, and was in the first instance (1844) referred by M'Coy to *Phillipsia*, with a note of interrogation. Later on, namely, in 1847, M'Coy proposed that this species should be placed under his genus *Brachymetopus*. We have no further information to give concerning *B. discors*, and the only additional specimen we have seen is from the Carboniferous Limestone of Little Island, Cork, and consists of an equally small pygidium to that described by M'Coy, and was obtained by Joseph Wright, Esq., F.G.S., of Belfast, to whom we are indebted for the opportunity of figuring the same.

The specimen is very obscure and not well preserved.

The following is Prof. M'Coy's original description of *Phillipsia* (*?*) (now *Brachymetopus*) *discors:*

"*Specific Characters.*—Pygidium semielliptical; axal lobe reaching to the margin, one third less in width than the lateral lobes, very convex, composed of seventeen narrow segments, the third and fourth unite in the middle of the lobe to form one large tubercle, and towards the apex there are four or five small tubercles, irregularly disposed; the lateral lobes have only six large rounded segments, each terminating at the margin in a large rounded tubercle, and having usually between the margin and the axal lobe two other large, obtuse tubercles, one of these, on the third and last, being largest, and probably spiniferous; besides these there are a few irregular granules, especially towards the apex; all the lateral segments seem forked from nearly their origin."

Prof. M'Coy adds, "I have included this very remarkable Trilobite in the genus *Phillipsia*, Portlock, although I think there can be little doubt, if better known, it would form a genus distinct from any of those already constituted; I have named it from the great difference in number of the segments of the axal and lateral lobes of the pygidium. Length of pygidium three lines, width four and a half lines; width of axal lobe one line."

Formation.—Carboniferous Limestone.

Localities.—Millicent Clane, Kildare; Little Island, Cork.

26. Brachymetopus hibernicus, *H. Woodw.*, 1883. Pl. VIII, fig. 16.

Brachymetopus hibernicus, *H. Woodw.* Geol. Mag., Decade ii, vol. x, p. 536, pl. xiii, fig. 3, 1883.

Cephalothorax unknown. Pygidium broadly semicircular, 13 mm. wide and 8 mm. long; axis narrow, $3\frac{1}{2}$ mm. broad and $6\frac{1}{2}$ mm. long, composed of 11 coalesced segments, each alternate ring ornamented by a small tubercle on the centre; border composed of 10 rounded pleuræ, which extend to the margin, becoming gradually more and more oblique until the last pair become nearly parallel behind, uniting the extremity of the axis with the posterior border. There is no ornament on the pleuræ.

This detached pygidium slightly resembles *B. discors* in general form, but is quite distinct and well marked. I feel satisfied that it belongs to *Brachymetopus*, but it cannot be referred to any species hitherto described, nor have I seen any other but the one figured, which is a very perfect and well-preserved specimen.

Formation.—Carboniferous Limestone.

Locality.—Kildare, Ireland.

Obtained by the present Earl of Enniskillen (when Lord Cole), and now preserved in the British Museum (Natural History).

Genus 4.—Proetus, *Steininger*, 1830.

When the earlier pages of this Monograph were passing through the press, I was not aware of the existence of any evidence in favour of the introduction of the genus *Proetus* into the catalogue of our British Carboniferous-Limestone Trilobites.

So long ago, however, as 1861, Prof. Dr. James Hall had identified a Trilobite from the Waverley Sandstone of New York State as *Proetus auriculatus* ('15th Report on State Cabinet of New York,' 1862, p. 107).

Dr. R. Richter, in his paper "Der Kulm in Thuringen" (in the 'Zeitschrift der Deutschen geolog. Gesell.,' 1864, Bd. xvi, p. 160, Taf. iii, fig. 1), describes and figures a small Trilobite under the name of *Proetus posthumus*, but there does not appear any special reason, save the narrowing of the glabella in front, for separating it from the genus *Phillipsia*.

In 1865, Messrs. Meek and Worthen also described a Trilobite from the Lower Carboniferous series (Kinderhook Group), Jersey, Co. Illinois, which they named *Proetus ellipticus* ('Geol. Survey of Illinois,' vol. iii, "Palæontology," p. 460, pl. xiv, fig. 8).

A third specimen described by Prof. Meek as *Phillipsia Lodiensis* ('Palæontology of Ohio,' vol. ii) should, he thinks (op. cit. p. 324), be called *Proetus Lodiensis* (the figure, however, is unsatisfactory).

There seems, therefore, no reason to doubt that the genus *Proetus*, hitherto known here only in the Silurian and Devonian, may have extended upwards into our Lower-Carboniferous series, as we find it on the American Continent.

It is important also that we should bear in mind the close family relationship which exists between *Phillipsia*, *Griffithides*, and *Proetus*; *Brachymetopus* alone enjoying any strongly-marked distinctive generic peculiarities.

The general form of the body is oval; and the trilobation very distinct through the entire length of body. The head is less than a third of the total length; the pygidium is rather longer than the head; the head-shield is always surrounded by a border, consisting of an exterior raised rim and an inner groove or furrow; the border is sometimes prolonged into a spine at the angle of the free-cheeks. The posterior margin of the head is formed by the grooved and furrowed border of the free-cheeks on each side and by the two basal lobes and the neck-lobe, which are separated from the glabella by a very distinct and deep furrow; the neck-lobe is broader than the free thoracic somites which follow it; the glabella is usually rounded and gibbous in front, but does not overhang its anterior border. (Barrande states that there are three pairs of short lateral grooves on its surface, although not always to be distinguished.) The axal furrows which surround the glabella are very distinct; the facial suture (which divides the fixed-cheek from the free-cheek) crosses the frontal border just in a line with the compound eye, above which it expands, forming a rounded palpebral lobe; then, passing down close to the line of the axal furrow, it diverges outwards and crosses the posterior border obliquely behind the line of the orbit. The free-cheek is triangular, its surface is convex, and upon the highest point is placed the large compound reniform eye, which either sometimes exhibits a faceted surface or is quite smooth, according to the state of its conservation.

Free thoracic segments, varying from eight to ten (*Proetus Barrandii*, Roemer, Devonian, Harz, has eight somites; nine and ten is the common number for the Silurian species). The axis is always strongly arched, and does not exceed the pleuræ in breadth; the breadth of the axis diminishes very gradually to the posterior extremity; the pleuræ are more or less bent at the fulcral point, and have their extremities either pointed or rounded, and their anterior margin faceted for rolling up.

The pygidium varies in its elevation, but the axis is always raised above the margin, and diminishes to a blunt extremity, leaving a smooth border beyond; the number of coalesced segments in the tail-shield varies (Barrande says from

four to thirteen in species found in Bohemia); the pleuræ do not extend to the margin of the pygidium, which is often smooth.

The surface of the test is most frequently smooth or finely granulated; in a few species it is striated; and rarely it presents a combination of both kinds of ornamentation.

Mr. J. W. Salter, in his "Palæontological Appendix" to the 'Memoirs of the Geological Survey,' 1858, vol. ii, part i, p. 337, writes as follows concerning the generic characters of *Proetus*:

"A very usual character of this genus is the possession of a strong tubercle, terminating the neck-segment on each side, and nearly separating it. Burmeister, however, in his second edition, has considered the species having this thickening and the obscure glabella furrows more strongly marked as forming a distinct genus, which he calls *Æonia*. M'Coy had anticipated him by a few months in the name of *Forbesia* without referring to *Proetus*. We prefer, with Lovèn, to consider both as belonging to one genus.

"The glabella shows two or three lateral furrows, but is sometimes quite smooth. Body-rings ten. The tail has but few lateral furrows, seldom more than seven or eight, and in this, as well as in the additional body-segment, the Silurian genus differs from the Carboniferous *Phillipsia* and *Griffithides*, which are else very nearly related to it."

27. Proetus? levis, *H. Woodw.*, 1883.[1] (See Woodcut, fig. 1.)

Phillipsia Brongniarti?, *Baily*. Mem. Geol. Surv. Ireland, Expl. Mem. Sheets 102 and 112, 2nd edit., p. 19, 1875.

Proetus? levis, *H. Woodw.* Geol. Mag., Decade ii, vol. x, p. 446, and woodcut, 1883.

Cephalothorax unknown.

Pygidium—22 mm. broad and 16 mm. long; smooth, semicircular, one fourth broader than long; axis convex, 7 mm. wide, one third the breadth of the pygidium at its anterior border, smooth, moderately elevated; axal furrows broad; where decorticated showing evidence of the coalescence of about twelve somites or rings 12 mm. long; tapering to a blunt extremity, which does not reach to the posterior margin, but leaves a smooth border 4 mm. wide behind it; pleuræ slightly convex, very indistinctly furrowed; margin

Fig. 1. Pygidium of *Proetus? levis*, H. Woodw. Carboniferous Limestone, Moneenalion, Co. Dublin. Enlarged nearly twice natural size.

[1] The existence of this specimen was not known until too late for insertion in the earlier pages of this Monograph. It should naturally be placed as the first genus instead of the fourth in our series.

entire, smooth, broad; general surface smooth, and destitute of ornamentation of any kind save a simple rib-like furrow and ridge where the pygidium unites with the free thoracic segments.

Formation.—Carboniferous Limestone.

Locality.—Moneenalion Commons, Co. Dublin. From the Survey Museum, Dublin. Kindly lent by Prof. E. Hull, M.A., LL.D., F.R.S., Director.

The specimen here described is the same recorded by Mr. W. H. Baily, F.L.S., in the Explanatory Memoir to Sheets 102, 112 (p. 19), as "*Phillipsia Brongniarti*," and was obtained from the Upper Limestones on the south side of Dublin, at Moneenalion Commons, about one mile south-east of Castle Bagot (Sheet 111). In the Explanation of Sheet No. 111 Mr. G. V. Du Noyer wrote (p. 21): "The general aspect of the Limestone varies between that of a palish and a dark grey compact rock; it is usually very fetid, and contains layers of chert.

"Some beds are very fossiliferous, and the Trilobite (*Griffithides*) is not uncommon in them; others consist almost entirely of crinoid fragments, large *Productæ* occurring sometimes in layers."

The specimen under consideration is embedded in dark (almost black) fetid crystalline limestone, full of crinoidal fragments and of Brachiopoda.

A careful comparison of this specimen with the pygidium described by Phillips (formerly called "*Ph. Brongniarti*," but now placed in the genus *Griffithides* under Phillips's original name of *obsoletus*) has satisfied me that they cannot possibly be placed together.

"*Ph. Brongniarti*" = *G. obsoletus*	compared with *Proetus levis*.
(*a*) Axis of pygidium nearly equal to half the breadth.	(*a*) Axis less than one third the entire breadth.
(*b*) Axis extremely gibbous.	(*b*) Axis but little elevated.
(*c*) Pleuræ very convex.	(*c*) Pleuræ almost flat.
(*d*) Axis and pleuræ very distinctly annulated.	(*d*) Axis and pleuræ very nearly smooth.
(*e*) Pygidium one fourth broader than long.	(*e*) Pygidium one third broader than long.

The fact of this abdominal shield from Co. Dublin being so unlike any one belonging to *Phillipsia* or *Griffithides* led me to compare it with those of other genera, and I was at once struck with its resemblance to the pygidia of *Proetus*. Seeing that in 1861, Hall had applied this generic appellation to a Carboniferous Trilobite from America, there cannot, I think, be any very great objection to its use here.

The pygidium is certainly new, and agrees with that of *Proetus* (*e.g. P. latifrons*) better than with any other genus with which I am acquainted.

Notes on the Discovery of Trilobites in the Culm-Shales of South-East Devonshire.

Although the Culm-deposits of Devonshire have long been known and studied, it has been a matter of considerable doubt as to the exact horizon which they really occupy. The Geological Surveyors have, it is true, spent much time in re-examining certain parts of the county, but owing to the smallness of the scale of the Ordnance Survey map (only one inch to the mile), and the inaccuracy of the topography, but little could be done to show the detailed work resulting from these later investigations.

Prof. J. Beete Jukes, F.R.S. ('Quart. Journ. Geol. Soc.,' 1866, pp. 320—371), and subsequently Mr. R. Etheridge, F.R.S. (op. cit., 1867, pp. 568—698), described the whole of the northern portion of the county afresh, whilst Mr. Horace B. Woodward, F.G.S., Mr. Clement Reid, F.G.S., Mr. W. A. E. Ussher, F.G.S., as representing the Geological Survey, have been engaged upon the more southern parts. Added to this Dr. Harvey B. Holl, F.G.S., Mr. A. Champernowne, F.G.S., and Mr. Jno. E. Lee, F.G.S., have contributed not a little to the elucidation of difficult parts of the Geology of South-Eastern Devon, whilst Mr. Townshend Hall, F.G.S., has done equally useful work in the northern area.

1839.—Sir H. T. de la Beche[1] notices the Culm-formation, and intimates (p. 117) that Prof. J. Phillips regarded the shale-fossils as belonging to the Carboniferous Limestone.[2] The list of plants which he gives contains a mixture of species, but many of those quoted are probably true Coal-Measure plants which do not occur in the Culm proper.[3]

1840.—Prof. Sedgwick and Sir R. I. Murchison in their memoir "On the

[1] 'Report on the Geology of Cornwall, Devon, and West Somerset,' 1839. See also 'Trans. Geol. Soc.,' 2nd series, vol. iii, p. 163.

[2] Judging from the *apparent* dip of the Culm-Measures beneath the Devonian rocks at Chudleigh, Sir H. de la Beche considered that this Limestone (which is now proved by its fossils to be the *Goniatites intumescens* Stage of the Upper Devonian, Roemer, 'Geol. Mag.,' 1880, pp. 145—147) was included in the Carbonaceous series, and as such it was originally engraved and published in his sections and coloured in the Geological Survey Map (Clement Reid, 'Geol. Mag.,' 1877, p. 454).

[3] Mr. R. Kidston, F.G.S., mentions (in a letter to the author) the following plants as determined by him from the Culm, viz.:

Asterocalamites scrobiculatus, Schlot., sp.
(= *Bornia radiata*, Brong.).
Calamites Roemeri, Göpp.
Sphenopteris, sp. nov.
Lepidodendron Rhodeanum (?), Sternb.
Lepidophloios, sp.
Halonia (fruiting branch of *Lepidophloios*).
Sigillaria (?).
Stigmaria ficoides, Brongt.

"All these plants," he adds, "have a 'Calciferous Sandstone' facies, and are equivalent to the 'Culm' of Germany."

Physical Structure of Devonshire, and on the Sub-divisions and Geological Relations of the Older Stratified Deposits,"[1] devote pp. 669—684 to a consideration of the "Culmiferous Series, its Relation to the other Formations, Structure, and Fossils." They mention (p. 678) that "in Ugbrook Park, near Chudleigh [in close proximity to Waddon-Barton, where the Trilobites were discovered by Mr. Lee], there is a large development of Culm Sandstone as coarse as Mill-stone grit, and passing into a conglomerate form; over it are some beds of more thin-bedded grey sandstone, not to be distinguished from a Coal-Measure sandstone, and containing very fine vegetable impressions, among which are well-marked *Calamites*. Indeed, through the whole of the upper group we are describing, vegetable impressions, though rarely so perfect as to give anything like specific characters, are extremely abundant." They add, "All the beds are intersected by numerous open joints, which in the coarser contorted beds are very irregular in their directions. But when the beds have a finer flaggy or shaly structure, the joints often become parallel (especially in a direction nearly transverse to the strike) so as to separate the strata into prismatic masses"[2] (p. 679).

"Among the more calcareous bands some are fossiliferous, containing a great abundance of at least two genera of bivalve shells; one a *Posidonia*" (*Posidonomya Becheri*, Bronn) the other of a genus not ascertained, but regarded as a marine shell. "In the same part of the series are *Goniatites* of at least two species, both of which are unquestionably marine, and (according to Professor Phillips) identical with *Goniatites* of the Yorkshire Coal-field."

After quoting Prof. Lindley's determinations of the Plants (pp. 681—682), the authors conclude: "On the whole, considering that the culmiferous rocks of Devon form a distinct group, with a peculiar mineral type (unlike the older groups, but nearly resembling the culmiferous beds of Pembrokeshire)—that they overlie all the other groups, and are overlaid by no rock newer than the New Red Sandstone—that, notwithstanding the paucity of fossils in the black limestone (in which respect it resembles the 'calp' of Ireland), there are in it one or two species not separable from known Mountain Limestone fossils, and, finally, that the flora of the Upper Culms, as far as it has been ascertained, agrees specifically with the known flora of the Carboniferous period; we think we have strong direct evidence to establish our position, "that the Upper Culm Strata of Devon are the geological equivalent of the ordinary British Coal-fields."

1842.—Mr. R. A. C. Austen,[3] whose paper was *read* December 13th, 1837, describes the culmiferous deposits of the South-East of Devonshire, and particularly

[1] 'Trans. Geol. Soc. Lond.,' second series, vol. v, 1840 (*read* June 14th, 1837).

[2] This paragraph gives a very exact description of the lithological characters of the beds at Waddon-Barton by Chudleigh, containing the Culm Trilobites.

[3] 'Trans. Geol. Soc. Lond.,' 1842, 4to, second series, vol. vi, "On the Geology of South-East Devonshire."

at Ugbrook Park, near Chudleigh, and other adjacent places, and states that Prof. Sedgwick considered them as a portion of the culmiferous beds of the centre of the county (p. 457).

Mr. Austen quotes a list of the plants, and adds (pp. 461-2), "This Flora, so far as it goes, is that of the Carboniferous period. In the black limestones occur *Goniatites mixolobus*, Phil., and *Goniatites crenistria*, Phil., Mountain Limestone species."

1867.—Sir Roderick I. Murchison, in the 1867 edition of 'Siluria' (p. 273), writes:

"Now, although this over-lying series is in mineral aspect as much unlike the Carboniferous strata of most other parts of Britain as the rocks of N. Devon are unlike the ordinary Old Red Sandstone of England and Scotland, we have proofs of fossils, besides the analogy with Pembrokeshire before spoken of, that the black limestones of Swimbridge and Venn, &c., with *Posidonomyæ*, do represent, on a miniature scale, a part of the Mountain or Carboniferous Limestone, that the next series of white grit and sandstone of Coddon Hill, &c., stands in the place of the Millstone-Grit, and that the overlying courses of Culm, with many remains of Plants, are consequently the equivalents of some of the lower coal-bearing strata of other tracts. In short, no one denies that in the Culm series of Devonshire we have the representatives of the Lower Carboniferous Strata."

1868.—Dr. Harvey B. Holl, in his paper "On the Older Rocks of South Devon and East Cornwall,"[1] describes the Carbonaceous Rocks or Culm-Measures very fully. He mentions the hard slates at Waddon-Barton over-lying the limestone, full of *Goniatites* and *Posidonomyæ*, above which are the typical Carbonaceous Sandstones quarried at Ugbrook Park. In conclusion, he refers to the memoir by Sedgwick and Murchison, and adds, "It is to these authors that we are indebted for having first pointed out the true position of these (Culm) rocks in the geological scale, when, by means of the included plant and other fossil remains, they identified them with the Coal-Measures of South Wales."

1875.—Mr. Townshend M. Hall,[2] in his 'Notes on the Anthracite Beds of North Devon,' writes, "In the North-Devon district the anthracite (Culm) is found in the Millstone-Grit, a series of beds belonging to the Carboniferous formation, but of an age immediately antecedent to that of the true Coal-Measures." The list of Culm-plants given by Mr. Townshend Hall, however, needs revision.

1876.—Mr. Horace B. Woodward, in his 'Geology of England and Wales,' pp. 106—111, gives a concise account of the literature of the Devonshire Culm-Measures. "Looked at in a large way, they consist of a series of shales, grits, chert-beds, with beds of limestone here and there." "Some authorities have placed them, generally, on the horizon of the Millstone-Grit, but there seems

[1] 'Quart. Journ. Geol. Soc. Lond.,' 1868, vol. xxiv, p. 401.

[2] 'Trans. Devonshire Association,' 1875.

reason to include with them representatives of at least a portion of the true Coal-Measures, and possibly also of the Carboniferous Limestone."

(1) The North Devon series of Carboniferous deposits about Barnstaple and Bampton is thus given by Prof. Phillips (p. 189):[1]

(*a*) "Upper part anthracitiferous, and containing ironstone, and by these characters agreeing with the Coal-deposits of Pembrokeshire. This is in general a Gritstone series, with plants of the Coal-formation."

(*b*) "Coddon Hill cherts, black-grits, jasper-rock, lydian-stones and shales of considerable, but variable, thickness; 1500 to 2000 feet (according to the Rev. D. Williams)."

(*c*) "Limestone and black shale with *Posidonomya*, *Goniatites*, &c. = *Posidonomya* (*Posidonia*) limestone of Swimbridge and Venn."

(*d*) "Black shale group."

(2) The South Devon strata about Trescott and Lew Trenchard have been thus divided (op. cit., p. 194):

(*a*) "Gritstone group of Central Devon."

(*b*) "Upper shale group—dark shales, carbonaceous grits and shales (equal to the Coddon Hill series."

(*c*) "Calcareous group—limestone of dark colour, and irregular bedding, with shales (*Posidonomya*)."

(*d*) "Lower shale group, with few fossils (no slaty cleavage)."

1882.—Dr. A. Geikie, F.R.S. (the present Director-General of the Geological Survey of Great Britain), writes in his 'Text-Book of Geology' (p. 748) as follows:

"In Moravia, Silesia, Poland, and Russia, the Carboniferous Limestone reappears as the base of the Carboniferous system, but not in the massive calcareous development which it presents in Belgium and England. One of its most characteristic phases is that to which the name 'Culm' (applied originally to the inferior slaty coal of Devonshire) has been given, when it becomes a series of shales, sandstones, greywackes, and conglomerates in which the abundant fauna of the limestone is reduced to a few molluscs (*Productus antiquus*, *P. latissimus*, *P. semi-reticulatus*, *Posidonomya Becheri*, *Goniatites sphæricus*, *Orthoceras striatulum*,[2] &c.). The *Posidonomya* particularly characterises certain dark shales known as 'Posidonomya schists.' About fifty species of plants have been obtained from the Culm, typical species being *Calamites transitionis*, *Lepidodendron veltheimianum*,

[1] 'Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset,' by Prof. John Phillips, F.R.S., 1841. 8vo.

[2] = *O. striolatum*, Sandb. The above-mentioned shells, which are all marine, occur in the Calciferous Sandstone around Edinburgh and in Fifeshire (see paper by Mr. R. Etheridge, junr., "On the Invertebrate Fauna of the Lower Carboniferous or Calciferous Sandstone of Edinburgh, &c.," Quart. Journ. Geol. Soc., 1878, vol. xxxiv, pp. 1—26, plates i and ii).

Stigmaria ficoides, *Sphenopteris distans*, *Cyclopteris tenuifolia*. This flora bears a strong resemblance to that of the Calciferous Sandstones of Scotland."

We are indebted to Mr. John Edward Lee, F.S.A., F.G.S., for the discovery of Trilobites in the lower Culm-shales of Waddon-Barton about two years since. The spot where the discovery was made, and which, up to the present time, is the only locality that has yielded these organisms, is the bankside of a steep lane leading at right angles from the ridge-road between Chudleigh and Haldon, and near the village of Waddon-Barton.

These Goniatite-shales, which break up (as so well described by Sedgwick and Murchison) into small cuboidal or prismatic fragments, are full of minute marine organisms. A list of these had been prepared by Mr. Lee, and to this Mr. Robert Etheridge, junr., and myself have contributed some additional species.

The main interest consists in the fact that these Goniatite-bearing shales agree almost exactly with the beds of corresponding age recently most carefully worked out and described by Prof. Dr. A. von Koenen, late of Marburg (now of the University of Göttingen), in a paper entitled "Die Kulm-Fauna von Herborn."[1]

Prof. Dr. A. von Koenen's paper is accompanied by two plates of Culm fossils, but he does not give figures of the two species of Trilobites which he refers to the genus *Phillipsia*, and he adopts the specific determinations of von Meyer and of Sandberger, whose figures are, however, not very satisfactory. We shall refer to these Culm species again further on.

The following is a list of species obtained by Prof. Dr. A. von Koenen from the Culm of Herborn, near Dillenberg:[2]

1. *Phillipsia æqualis*, v. Meyer.
2. *P. latispinosa*, Sdbg.
3. **Cypridina subglobularis*, Sdbg.
4. **Goniatites mixolobus*, Phill.
5. *G. crenistria*, Phill.[3]
6. *Aptychus carbonarius*, v. Koen.
7. *Orthoceras scalare*, Gldf.
8. **O. striolatum*, v. Meyer.
9. *O. cf. giganteum*, Roemer.
10. *O. cf. inæquale*, Roemer.
11. *O. undatum*, Flem.
12. *Orthoceras*, sp.
13. *Bactrites*, sp.
14. *Gyroceras serratum*, de Kon.
15. *Nautilus*, sp.
16. *Nautilus*, sp.
17. *Hyolithes Roemeri*, v. Koen.
18. *Terebratula hastata*, Sow.
19. *Camarophoria papyracea*, Roem., sp.
20. *C. triplicata*, v. Koen.
21. *Spirifer? makrogaster*, Roemer.
22. *Orthis concentrica*, v. Koen.
23. *Productus cf. sublævis*, de Kon.
24. **Chonetes deflexa*, v. Koen.
25. **C. rectispina*, v. Koen.
26. *Pecten densistria*, Sdbg.[3]

[1] See Leonhard und Geinitz's 'Jahrbuch für Mineralogie, &c.,' 1879, pp. 309—346, pls. 6 and 7.

[2] Those marked with a * are considered to occur in the Culm-shales of Waddon-Barton, Devon. Probably several others should also be identified, but they require actual comparison with each other to determine this with certainty.

[3] Mr. Jno. E. Lee believes these should also be added to the Culm-list of fossils from Devonshire.

27. *P. Losseni*, v. Koen.
28. *P. prætenuis*, v. Koen.
29. *P. perovalis*, v. Koen.
30. *Aviculopecten cf. papyraceus*, Sow.
31. **Avicula lepida*, Gldf.
32. *A. latesulcata*, v. Koen.
33. *A. Kochi*, v. Koen.
34. **Posidonomya Becheri*, Gldf.
35. *Myalina mytiloïdes*, v. Koen.
36. *Arca Rittershauseni*, v. Koen.
37. *A. cf. arguta*, Phill.
38. *A. Decheni*, v. Koen.
39. *Poteriocrinus regularis*, H. v. Meyer.
40. *Lophocrinus speciosus*, H. v. Meyer.
41. *Cyathophyllum*, sp.
42. *Listrakanthus Beyrichi*, v. Koen.
43. *Cladodus striatus*, Ag. ?
44. Fish-jaw. ?

List of fossils from the Lower Culm-shale of Waddon-Barton, near Chudleigh, Devonshire, revised and augmented by Mr. R. Etheridge, junr., and Dr. H. Woodward, from Mr. Lee's collection, and from other sources.

Genera, Species, and Remarks.

1. *Orthoceras striolatum*, Sandb. (chiefly as external casts).
2. — sp. (there are probably more than two species of *Orthoceras*).
3. *Goniatites mixolobus*, Phill. (as figured by Roemer).
4. — *sphæricus*, Martin, sp. (as figured by Roemer).
5. *Posidonomya Becheri*, Bronn.
6. — *corrugata*, Eth. (? or young of *P. Becheri*).
7. *Pecten*, sp. nov. ? (of a Carboniferous facies, but differing from any figured by von Koenen).
8. *Pteronites*, sp. (form related to *P. persulcatus*, M'Coy).
9. — sp. (form related to *P. latus*, M'Coy).
10. *Avicula lepida*, Goldf.
11. *Chonetes rectispina*, von Koenen.
12. — *deflexa*, von Koenen.
13. *Spirifera Urii*, Fleming.
14. *Fenestella*, sp. (in the condition known as *Hemitrypa Hibernica*, M'Coy).
15. *Phillipsia Leei*, H. Woodw. (Pl. X, figs. 1, 2, 3, 4).
16. — *minor*, H. Woodw. (Pl. X, figs. 5, 6 *a*, *b*, 7, and 8 *a*).
17. — *Cliffordi*, H. Woodw. (Pl. X, figs. 8 *b*, 9, 10, 11, 12).
18. — *articulosa*, H. Woodw. (Pl. X, figs. 6 *c*, *d*, and 13).
19. ? *Bernix Tatei*, Jones (this form also occurs in the "Tuedian").
20. Casts of small corals (probably *Monticuliporidæ*).
21. Casts of small bodies (probably Sponge-Spicula).

It is highly probable, when more of the shale shall have been carefully examined, that many other small organisms will be added to our list, but the intractable nature of the matrix has precluded our doing more at present.

It may be interesting to record the fact here that in the "Tuedian" group or

Lower Carboniferous of Budle, Northumberland, Prof. G. A. Lebour has obtained *Posidonomya Becheri* identical with that of Devonshire.

"The Tuedian group (says H. B. Woodward) and the Lower Limestone shale are homotaxial with the Calciferous Sandstone group of Scotland" ('England and Wales,' p. 78).

Whatever may be finally decided to be the exact horizon of the Culm-Measures near Bideford I think it can no longer be denied that the *Posidonomya* and Goniatite shales of both North and South Devon are really (as suggested by Dr. A. Geikie, and now shown from their fossil contents by Mr. Jno. E. Lee) at the very base of the Carboniferous series, and are equivalent to the Lower Carboniferous series of the Rhenish Provinces and the Hartz.

There is little doubt also that the plant-remains which occur in the associated sandstones of the same regions are older than those of the Millstone-Grit series, and must be correlated with those of the Calciferous sandstones around Edinburgh.

The Trilobite remains from the Culm-shales of Waddon-Barton, Devonshire, are met with in the same condition as the *Goniatites* and other fossils with which they are associated. They are all highly compressed and often considerably affected by cleavage, causing them to be more or less distorted.

I recently visited Waddon-Barton, Chudleigh, and many of the localities for Culm-shale fossils with Mr. J. E. Lee, and I also spent a week in breaking up hundreds of pieces of the shale, two cartloads of which had been procured by Mr. Lee from Waddon-Barton with the permission of Lord Clifford. Out of this I obtained a large number of these Trilobites and other organisms with my own hands in addition to those already obtained by Mr. Lee.

Out of a series of nearly fifty specimens thus obtained, I have been able to determine four distinct species. They are all in a very fragmentary condition, the individuals varying from 10 millimètres in length (Pl. X, fig. 7 *a*) to 23 mm. and upwards (Pl. X, fig. 2).

As is the case in other deposits of Carboniferous age, it is most rare to meet with specimens having the head, thorax, and abdomen united. Only two approaching this state have been discovered as yet; the majority disclose evidence of detached pygidia, whilst head-shields and thoracic rings are but rarely found.

Making allowance for the effects of compression and distortion which the specimens have undergone, they are probably all referable to the genus *Phillipsia*, and strongly resemble in their mode of preservation the specimens of *Phillipsia Colei* from Ballintra and Carrickbreeny, Donegal, and of *Phillipsia truncatula* from Hook Point, Co. Wexford, Ireland.

28. Phillipsia Leei, *H. Woodw.*, sp. nov. Pl. X, figs. 1, 2, 3, and 4.

This is one of the largest of the Culm Trilobites, and is represented by numerous specimens.

The head-shield is semicircular in outline, the glabella occupying about one-third of its breadth at the widest part of the head, the glabella is moderately elevated, and is surrounded by the flattened border of the fixed cheek, which expands in front, forming a flat and somewhat broad semicircular border around the anterior portion of the glabella. Two small basal lobes are seen one on either side near the posterior margin of the glabella, and two short oblique furrows mark its sides. The neck-lobe is well defined and somewhat strongly arched, and is widest in the centre; the facial suture separating the free-cheek crosses the neck-lobe obliquely along its pleural portion close to the axal furrow; a deep furrow circumscribes the border and separates the raised inner portion of the free-cheek from the flattened margin of the shield which in its decorticated condition is seen to be ornamented by parallel lines. The angles of the head-shield are produced into strong rather broad spines about two-thirds as long as the head. The eyes are very small, semilunar, and often quite obliterated by compression.

Thoracic segments.—The axis of the thorax is somewhat wider than its pleuræ, the separate segments are distinctly marked by deep furrows, each of the pleuræ being marked by a central groove; their extremities are rounded; the thoracic segments were probably nine in number, but the whole number cannot be seen in any one specimen.

The pygidium is one-fifth broader than long, the axis forms one-third of its breadth at the proximal border, but diminishes very rapidly, terminating in a somewhat blunt point near the posterior margin.

There appear to be about fourteen coalesced segments in the axis of the pygidium represented by about nine grooved pleuræ on each side, surrounded by a narrow smooth border.

This species, which we have dedicated to the discoverer, Mr. John Edward Lee, F.S.A., F.G.S., of Villa Syracusa, Torquay, presents affinities with *Ph. gemmulifera*, *Ph. truncatula* and *Ph. Eichwaldi*, in all these species the angles of the head-shields are produced into lateral spines, and the flattened border of the glabella encircles the raised central portion, but the eyes in *Ph. Leei* are exceedingly small, whereas in all the other species of *Phillipsia* they are very large and prominent.

Ph. Leei differs from *Ph. Colei* in possessing cheek-spines. The pygidium of *Ph. Leei* is also distinct, being narrower and more pointed in its axis; the tail-shield itself is also more triangular in outline.

We have compared *Phillipsia Leei* with *Proetus posthumus* of Richter[1] to

[1] 'Zeitsch. Deutsch. geolog. Gesells.,' 1864, Bd. xvi, p. 160, Taf. iii, fig. 1.

which it approaches, but in Richter's figure the glabella is narrow in front and broader behind, whereas our Culm form is just the reverse. Prof. A. von Koenen, p. 312, op. cit., places Richter's *P. posthumus* with *Phillipsia æqualis*, H. von Meyer, and observes, "As von Meyer expressly says that the glabella is reduced in front, there is no doubt that Burmeister was in error in figuring as this species a form with a club-shaped glabella. Emmrich's restored figure does not give a good representation of the species; the head-shield is too long, the eyes placed too far in front, and the glabella too slightly reduced in front. The form placed by Roemer under *Phillipsia latispinosa*, from the Silesian Culm of Bantsch appears to me, on account of the very wide glabella, to belong to *P. æqualis*. Near Nehden I have found an example of which the tail is 15 mm. wide and 10 mm. long, and fragments of still larger dimensions occur at Aprath" (op. cit., p. 313).

We figure here a specimen of Culm with two compressed Trilobites thereon referred to *Phillipsia*, which were obtained at Aprath by Mr. J. E. Lee, F.G.S., of Torquay; but the cheek-spines are wanting in both, although the eyes can be discerned with a high power, and there are faint traces on one of the obliquely transverse furrows on the glabella. A reference to *Cylindraspis latispinosa*, of Sandberger (taf. iii, fig. 4 and 4 *a*) shows that the glabella of this species is also more pointed in front than in our British species; the facial suture is close to the glabella, as in other *Phillipsiæ*.

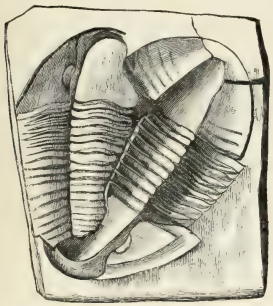

FIG. 2.—*Phillipsia æqualis,?* H. v. Meyer.
Culm, Aprath, Germany. Enlarged twice natural size. From the collection of John Edward Lee, Esq., F.S.A., F.G.S., of Torquay.

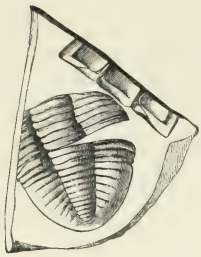

FIG. 3.—*Phillipsia*, sp.
From Culm-shale (Lower Carboniferous), near Marburg, Germany. Enlarged twice natural size. From the collection of John Edward Lee, Esq., F.S.A., F.G.S., Torquay.

We ought to add that von Meyer's figure of *? Calymene* (*Phillipsia*) *æqualis* ('Nova Acta,' vol. 15, 2 s., p. 100, Taf. 56, fig. 13) has no cheek-spines and no eyes, nor are any sutures shown in the head-shield.

The only other German Culm Trilobite we have had the opportunity to study is a compressed body and pygidium with the basal part only of the head-shield preserved in a piece of shale from near Marburg obtained by the Rev. G. F. Whidborne, M.A., F.G.S., who presented it to Mr. J. E. Lee, F.G.S., of Torquay, in whose cabinet I found it. (See woodcut fig. 3, p. 67.)

It agrees most nearly with our *Ph. Cliffordi* as regards the pygidium, which, however, consists of fewer segments, and the base of the head-shield shows that the Marburg specimen had not (apparently) any cheek-spines to the cephalon.

Formation.—Lower Culm.

Locality.—Waddon-Barton, near Chudleigh, Devon. From the Collection of Mr. J. E. Lee, F.S.A., F.G.S.

29. Phillipsia minor, *H. Woodw.*, sp. nov. Pl. X, figs. 5, 6 *a*, *b*, 7, and 8 *a*.

This is the smallest Carboniferous Trilobite which I have studied, being only half the size of the smallest specimen of *P. Colei*, Pl. II, fig. 1.

Head-shield rounded in front, one-third broader than long; the glabella occupies one-third of its breadth, and is oval in outline, slightly broader in front, tumid, with distinctly marked basal lobes; lateral furrow indistinct; surface of glabella and free-cheeks covered with minute puncta; neck-lobe rather deep and prominent, free-cheeks having a furrow around the margin parallel to the border; angle of cheek produced into a short slightly curved spine.

Thorax consisting probably of nine segments; axis very distinct, forming one-third the entire breadth of body; axal furrows well defined, each pleura strongly grooved down the centre; extremities rounded. The eye is considerably larger in this than in the preceding species, but can only be distinctly seen on the free-cheek (fig. 7 *c*).

Pygidium one-fifth broader than long; the axis forms one-third of the breadth at the proximal border, but diminishes rapidly to a somewhat acute point at rather less than one-fourth of its entire length from the posterior margin. There are fourteen segments in the axis and ten lateral pleuræ which bifurcate as they approach the margin of the shield.

Hypostome (Pl. X, fig. 7 *h*). There seems but little reason to doubt that the detached free-cheek (*c*) and the hypostome (*h*) lying upon the same slab with the nearly entire specimen of *P. minor* really belong to one and the same specimen.

The hypostome is as broad as it is long, the anterior margin once attached to the underside of the front of the head-shield is rounded in contour, and expands laterally into two small lobes; posteriorly the hypostome is elongated into a

pentangular lobe with a slightly raised margin, and a rounded central depression, the surface of which is striated.

The head of *P. minor* appears to us to be very distinct from any of the species of Carboniferous Trilobites hitherto figured, but the pygidium may be compared with *P. Eichwaldi* (Pl. IV, figs. 9 and 13); the axis, however, in *P. minor* tapers more rapidly to a point.

Formation.—Lower Culm.

Locality.—Waddon-Barton, Devonshire.

Figs. 6 and 7 are preserved in the British Museum (Natural History), and figs. 5 and 8 *a* are in the cabinet of Mr. J. E. Lee.

30. Phillipsia Cliffordi, *H. Woodw.*, sp. nov. Pl. X, figs. 8 *b*, 9, 10, 11, 12.

The head of this species resembles that of *P. Leei*, but the cheek-spine is much shorter, and the lateral furrows on the glabella are more marked. The head is much distorted by cleavage, and its accurate description is attended with some difficulty, the head being imperfect. Thoracic segments unknown, probably nine in number.

Pygidium.—We are fortunately able to figure five pygidia of this species having well-marked characters of their own. The tail-shield is nearly twice as broad as it is long, the axis is one-third of its breadth at the proximal border, but rapidly diminishes to one-seventh at its bluntly-rounded extremity; here the shield is bordered by a wide margin covered with fine concentric striæ (being an impression of the underside); the border is one seventh the length of the pygidium, but diminishes in width laterally. The axis of the tail is composed of thirteen coalesced rings or somites, and has ten lateral pleuræ on each side; these bifurcate near their extremities as they approach the margin. There are no puncta, spines, or tubercles observable on this species.

The pygidium of *Ph. Cliffordi* agrees most in general facies with that of *Ph. Colei* (Plate II), but in the former the pleuræ are bifid at their extremities, not simple as in the latter species. It may also be compared with *Griff. Carringtonensis* (Pl. IX, figs. 6 *a*, *b*), but the Culm form is broader and shorter in proportion.

I have much pleasure in dedicating this species to Lord Clifford, of Ugbrook Park, Devonshire, upon whose estate the Culm is well exposed. These Trilobites were discovered by Mr. Lee on one of his lordship's farms at Waddon-Barton, and it was by his permission that Mr. Lee secured a quantity of the shale to break up, resulting in the discovery of the specimens here figured.

Formation.—Lower Culm-shale.

Locality.—Waddon-Barton, near Chudleigh, Devonshire.

Figs. 8 *b*, 9, 11, and 12, preserved in Mr. J. E. Lee's cabinet, Villa Syracusa, Torquay.

Fig. 10 preserved in the British Museum (Natural History).

31. Phillipsia articulosa, *H. Woodw.*, sp. nov. Pl. X, figs. 6 *c*, *d*, and 13.

This species is based upon three pygidia of Trilobites having a larger number of coalesced segments than any of the Culm specimens here noticed. We are unable to refer any cephalothorax as belonging to this form of pygidium, and can only therefore note its occurrence.

Pygidium one-fourth broader than long, axis one-third the entire breadth, consisting of seventeen coalesced segments which diminish rapidly in breadth to the extremity, which is bluntly rounded, and less than one-third the breadth the axis at the proximal end; axal furrows deeply marked. Pleuræ thirteen in number, terminating abruptly within the margin, which is finely striated; neither axis nor pleuræ have any ornamentation upon them.

This pygidium agrees most nearly with the preceding species, from which, however, it differs in possessing a greater number of coalesced somites, a character which seems sufficient to justify its separation.

Formation and locality the same as that of the preceding species.

These specimens are preserved in the British Museum (Natural History).

APPENDIX.

Note on the Nature of Certain Pores Observable in the Cephalon or Head-shield of some Trilobites. (Plates IV and IX.)

Among the numerous specimens of Carboniferous Trilobites which I have had the opportunity to examine during the last three years, many examples exhibit a peculiarity of structure which had already arrested the notice of such keen observers as Portlock, M'Coy, Oldham, Salter, Barrande, and Valerian von Möller. I allude to certain pores more or less well-marked, and placed usually one on either side of the glabella in the axal furrow, and upon the facial suture which separates the free-cheek from the fixed one, forming the margin of the glabella, and just in front of the compound eyes (see Plate IV, figs. 6, 8 and 10, p. 22).

In working at the Silurian Trilobites Professor F. M'Coy, in his 'Synopsis of the Silurian Fossils of Ireland, collected by Sir Richard Griffith' (Dublin, 1846, 4to, p. 43), writes, "I have observed in several Trilobites a peculiar pore situated in the furrow which separates the glabella from the cheeks near the anterior margin on each side, which seems to have escaped general notice, and which it is not impossible may be the remains of setaceous external antennæ." Professor M'Coy thinks these pores occupy just the position which the antennæ would have occupied, and that antennæ, being hollow organs, would leave a hole in the external integument if broken off. He then proceeds to observe that "in *Ampyx* these punctures are extremely remarkable and obvious, and it is only in this group that they have, to my knowledge, been observed by naturalists. Captain Portlock[1] having noticed them, but without any remark, in the description of his *A. Sarsii*. They are to be seen, but not exactly in the right place, in his figure of that fossil, in which they form two very deep, oblong punctures, communicating with the interior; they are situated in the furrow before-mentioned, about their own length within (or posterior to) the anterior margin. I have likewise observed them in all the species of the genus *Trinucleus*. In *T. Caractaci* they form two rather large circular punctures, as large as one of the punctures of the wings; they are in the

[1] 'Report on the Geology of the County of Londonderry, and of parts of Tyrone and Fermanagh' (Dublin, 1843), p. 261.

furrows before mentioned, close to the anterior margin of the cheeks, communicating with the interior. In *T. seticornis* they form two small circular punctæ within the margin; they are in the same furrows, penetrate to the interior, and are smaller than the punctures of the wings. In *T. radiatus* they hold the same position as in *T. Caractaci*, that is, very close to the anterior margin of the cheeks. They are rather larger in *T. elongatus*, in which they occupy the same position as in *T. Caractaci*, but are smaller, and placed rather more within the margin. In *T. fimbriatus*, though small, they are very conspicuous, being about the size of one of the punctures of the margin of the shield, and their own diameter within the margin. It is very remarkable that those organs are most obvious in what are considered *blind* Trilobites; whether it may be as a compensation for the want of eyes that they are furnished with better-developed antennæ, organs seeming so mysteriously to combine in themselves the exercise of all the senses, besides their own aeroscepsin, as Lehmann calls it, I am unable to conjecture."

He adds "that these punctures exist, although very much reduced, in Trilobites with eyes, I have also ascertained, as they are found, although exceedingly minute, in the common *Griffithides globiceps* of the Carboniferous Limestone, holding the same position as in the other genera alluded to, being seated in the same furrows, but farther back from the anterior margin."

Dr. T. Oldham, F.R.S., in the 'Journ. Geol. Soc.,' Dublin, 1846 (vol. iii, part 3, p. 189), writes in his description of *Griffithides globiceps*: "In the furrows which separate the cheeks and glabella, about half way between the front of the eye and the anterior margin, I have observed in all the tolerably preserved specimens which I have seen, a small hole or indentation. These are constant and therefore obviously connected with the structure of the creature, although I cannot offer an explanation of their use. They are similar to those noticed by Portlock in his *Ampyx Sarsii*" (op. cit., p. 261).

In 1847, Mr. J. W. Salter communicated a paper to the Geological Society, "On the Structure of *Trinucleus*, with remarks on the species" ('Quart. Journ. Geol. Soc.,' 1847, vol. iii, pp. 251—254), in which he observes: "The peculiar perforated border is the most interesting part of these animals, and I propose to examine it critically.

"The puncta are almost always arranged in radiating rows, three, four, or more holes in each row, and these being at equal distances they form concentric lines. In *T. granulatus*, two of these rows are separated by a furrow from the rest; in *T. seticornis*, three are distinct from the remaining two or three, by the front rows being sunk in a deep concentric furrow. Other modifications take place; in *T. fimbriatus*, the two front rows are turned downwards; lastly, in *T. ornatus*—for by that name we must call *T. Caractaci*—the dots occur most frequently in quincunx order, *i.e.* the radiant rows appear zigzag and not direct;

this appearance is due to the great obliquity of the ray. I wish to call attention to this, because I consider it enables us to understand the nature of the enigmatical puncta. If we suppose a head furnished with a produced membranous margin instead of a perforate one, we shall get at the explanation by supposing the membrane to collapse at regular intervals, become plicate, then perforate, and lastly, separate into linear processes. Now we have in *Harpes* the flat border, with rows of impressed puncta, which have not yet perforated the fringe. In *Trinucleus fimbriatus*, we have a plicate border, the thin interstices of which have contracted into pores, which is a step beyond the simple perforation in linear series exhibited by *T. ornatus*. Lastly, in *Ceraurus* (*Acidaspis*, Murch.), we have the structure completed, the linear processes being quite separated into spines. This structure is not anomalous, for the cellular membrane which forms the inner peristome of the mass passes through an exactly similar course, becoming in different species perforate, in others separated into distinct teeth.

"That these perforate or spinous fringes are not essential, but only supplementary parts of the head, may easily be shown by the fact that the width of the head, without the fringe, is exactly that of the body, and when the animal is doubled up the fringe projects freely on all sides. We still require to find anomalous specimens in which all or some of the above modifications, plications, perforations, or partially cleft borders, may be exhibited together, in order to demonstrate the supposed origin of the structure" (p. 253).

In another paragraph in the same paper Salter refers to the discovery by himself and Emmrich of the facial suture in *Trinucleus ornatus*. "Its course," he states, "is obliquely upwards from the eye tubercle to the upper end of the glabella, where it appears to terminate in a solitary deep perforation, similar to those which surround the head" (*op. cit.*, p. 251). It is to these pair of deep puncta, one on either side of the head, that we would specially draw attention.

Later on (in 1852) M. Barrande, in his "Système Silurien de la Bohême" (vol. i, *Trilobites*, p. 230), thus wrote: "On the antennæ of Trilobites:—Prof. M'Coy, in his work already cited (p. 43), announces what he deems to be the discovery of the remains of antennæ in the form of a deep pore on either side of the frontal lobe in the groove which surrounds the glabella. He enumerates the genera *Trinucleus*, *Acidaspis*, *Calymene*, *Ampyx*, *Griffithides*, &c., in all of which this observer states he has succeeded in tracing these organs. We have also remarked these puncta long since in a variety of Trilobites from Bohemia, notably in *Calymene*, *Trinucleus*, *Cheirurus*, but we have been led to offer a different interpretation to that indicated above.

"First, we have to observe that if this cavity does not appear to be anything else but a pore in those species with a border, as *Trinucleus*, it assumes larger and larger dimensions as it approaches the edge of these Trilobites, and forms a

funnel-shaped opening nearly 2 mm. in diameter in the head of *Cheirurus claviger*."[1]

"When the shell exists, as we have seen it in specimens of *Calymene Baylei*, *Cheirurus gibbus*, &c., it is bent inwards, as a funnel-shaped depression. We have thought that this bending inwards of the shell was simply designed to afford points of attachment for the muscles of the jaws, and that they had the same origin as the similar indentations which we have indicated in the pleuræ of various species of Trilobites. We have observed the conformity of the position of these pits in the depression of the axial furrows of the thorax as in the head. We recall again the indentations of the shell on the glabellal furrows and on those of the axis of the pygidium in *Dalmannia*.

"We were satisfied with these analogies, and we sought no other explanation for these little indentations. But after having read the opinion of Prof. M'Coy, we have studied all the specimens afresh which might serve to elucidate this question, and we have found a portion of a *Cheirurus gibbus*, which seems to explain the matter satisfactorily to our views. This fragment is broken along the line of the dorsal groove and the length of the glabella, exposing to view one of the alæ of the hypostome *in situ*. This wing of the hypostome fits at its extremity to the interior of the little funnel-shaped projection formed upon the underside of the head-shield. These details are very distinct, owing to the very perfect preservation of this specimen with its shell. After this we cannot accept any other interpretation for the genus *Cheirurus* than that which we have given. We leave to savans the task of pointing out the value of these analogies, and they may be able to apply this method of explanation to other genera mentioned by Prof. M'Coy" (*op. cit.*, p. 230).

Valerian von Möller, in his paper ("Ueber die Trilobiten der Steinkohlenformation des Urals") contributed to the 'Bulletin de la Société Impériale des Naturalists de Moscou," 1867, p. 44, notices these same pores in the head of *Phillipsia Eichwaldi* as "very distinct deep funnel-shaped openings, which run a little obliquely and enter into the underside of the cephalothorax." He cites the opinion of M'Coy and of Barrande, and says, in conclusion, "I quite agree with the observations of Barrande, and I feel sure the more one examines these indentations the more one feels satisfied that they are only superficial openings."

I have carefully examined these puncta in the Carboniferous Trilobites, and have sought for some satisfactory explanation in various other members of the class Crustacea, both recent and fossil.

[1] This is not shown in Barrande's figures of *Cheirurus claviger*, pl. 40, figs. 1—12, nor in *Ch. gibbas*, figs. 35—39, but is seen in pl. 41, fig. 17; it is also well shown in *Trinucleus ornata*, pl. 29, figs. 1—8, and in *Placoparia Zippei*, pl. 29, figs. 30—34, and in *Calymene Baylei*, pl. 43, fig. 49, and in many others not referred to by Barrande.

And first I would observe, in reference to the varied forms of *Trinucleus*, with corrugated, punctate, perforate, and serrated margins to the head-shield, that we may see in the larval "king crab" or "horse-shoe crab" (*Limulus polyphemus*) of North America just before hatching, that the head-shield retains indications, in the well-marked fimbriated hepatic lobes, of the presence of a once divided border, corresponding with the five or six distinct cephalic somites. This fimbriated margin to the cephalic shield, seen in the young of *Limulus*, is observable also in the head-shield of *Hemiaspis limuloides* from the Lower Ludlow of Shropshire. As to the explanation given by M. Barrande for the series of depressions, or invaginations, of the crust, of various Trilobites which are seen to correspond with each thoracic somite, and are placed exactly in the depression of the furrow on each side of the dorsal axis, and are even observable in the axal furrows of the pygidium of *Dalmannia*, we agree with him entirely, and there can be, I think, no doubt whatever that they are perfectly homologous with the similar pits or indentations of the crust, observable in the thoracico-abdominal shield of *Limulus*, which gives rise to six powerful calcareous processes within (*Apodemata*, Milne Edwards; *Entapophyses*, Owen) for the attachment of the muscles required for the locomotory organs.

But whether the two pits or pores placed one on each side of the glabella, in front of the compound eyes, are of the same nature (as Barrande assumes them to be) is an open question. That they are not the remains of *Antennæ*, as supposed by Prof. M'Coy, I think we may feel quite satisfied, as we know of no Crustacean whatever with antennæ arising from the *dorsal* aspect of the cephalic shield in the manner supposed by M'Coy.

The antennæ are either on the *margin* of the head as in many Isopods (see Plate IX, figs. 8 and 9), or *beneath* as in *Limulus*, *Apus*, and other forms of Entomostraca.

Mr. John Young, F.G.S., of the Hunterian Museum, in the University of Glasgow, a most careful observer, and to whom I am indebted for the loan of many interesting specimens of Carboniferous Trilobites, several of which illustrate this point in an admirable manner, suggests, in a note to me, that he has long thought that these puncta might possibly prove to be *ocelli*. Whether this be the correct interpretation or not, at any rate it seems a more plausible hypothesis than that suggested by Prof. M'Coy.

It is true that such an association of larval eye-spots with compound eyes has not as yet been met with in any of the Trilobita, but it occurs in the Merostomata, both recent and fossil (*Pterygotus*, *Slimonia*, and *Limulus*), and its discovery would be hailed as further evidence in favour of the undoubted close affinities of both these groups with the *Scorpionidæ*, and so with the Arachnida.

We have noticed two instances of pores in the *Isopoda*, and it is probable that

the researches into the "Challenger" collections now in progress will reveal many others in this interesting group. In one instance, *Sphæroma* (Pl. IX, fig. 9), the pore seems really to be on the line of the suture of the glabella, the free cheeks of the Trilobite being represented in the Isopod by the first thoracic somite which wraps around the sides of the head in a similar manner.

In *Serolis* (Pl. IX, fig. 8) the pore, which forms rather an elongated slit (*p*), is in the centre of the margin of the first thoracic somite, at a distance from the compound eye, and has no relation to any suture. These puncta may be, like the *fenestræ* in the head of *Blatta orientalis*, either rudimentary ocelli or the seat of some other nerve-sense, and may have been, as in *Blatta* and in *Serolis*, covered with a thin transparent portion of the integument, which served either as a simple eye, a tympanum, or an olfactory pore. We have referred to these *fenestræ* in the head of *Blatta* because they are placed, like those in the Trilobites, *on a suture* of the head, and in front of the compound eyes.

We hope to have some further information to offer on this subject upon a future occasion, meantime other workers may be able to assist with suggestions and specimens to elucidate this interesting point, for which we shall be only too thankful.

On the Occurrence *of the Genus* Dalmanites *in the* Lower Carboniferous Rocks *of* Ohio. By Prof. E. W. Claypole, B.A., B.Sc. (Lond.), F.G.S., of Buchtel College, Akron, O., United States. (See 'Geol. Mag.,' 1884, p. 303.)

Of the abounding Trilobites which mark the faunas of the Lower and Middle Palæozoic rocks few survive into the Upper Palæozoic. Three genera, if indeed they really deserve that name, have been described from the Carboniferous beds in England—*Phillipsia*, *Griffithides*, and *Brachymetopus*. Only the first of these is yet known to occur in American Palæozoic strata. But on the other hand two species of *Proetus* have been announced from America—a genus not yet recognised in England.[1] It is true that the distinctions are so slight that possibly these last might be as correctly referred to *Phillipsia* as to *Proetus*. As they stand, however, the distribution of the North American Carboniferous Trilobites is as follows:

Distribution of North American Carboniferous Trilobites.

Coal-Measures	*Phillipsia Cliftonensis*, Shum. 1858.
	„ *major*, Shum. 1858.
	„ *Sangamonensis*, M. and W. 1865.
	„ *scitula*, M. and W. 1865.
Chester Group	„ *Meramecensis*, Shum. 1855.
	„ *Stevensoni*, Meek, 1871.
Keokuk Group	„ *Lodiensis*, Meek, 1875.
	Proetus [2] *auriculatus*, ? Hall, 1861.
Cuyahoga Shale	*Phillipsia bufo*, M. and W. 1870.
	„ *Portlocki*, M. and W. 1865.
Burlington Group	„ *insignis*, Win. 1863.
	„ *tuberculata*, M. and W. 1870.
Kinderhook	„ [3] *Doris*, Win. 1865.
	„ *Rockfordensis*. Win. 1865.
	„ [4] *Missouriensis*, Shum. 1858.
	„ *Tennesseensis*, Win. 1869.
	Proetus *ellipticus*, M. and W. 1865.

[1] See *ante*, p. 57. Prof. Claypole had not seen my notice of *Proetus*, from the Carboniferous Limestone of Ireland, when this was written.—H. W.

[2] Assigned in Miller's 'Catalogue of N. A. Palæozoic Fossils' to the Chemung Gr.

[3] Omitted from Miller's 'Catalogue.'

[4] Assigned to the Coal-Measures in Miller's 'Catalogue.'

Two other Canadian species of uncertain horizon complete the list:

Phillipsia Howi, Billings, 1863.
„ *Vindobonensis*, Hartt, 1868.

On both sides of the Atlantic, therefore, so far as I am aware, the Carboniferous Trilobites without exception belong to the type possessing a pygidium with definite, even outline, like that of the two genera given above. It is true, Meek says, in his description of *Phillipsia Lodiensis* ('Pal. of Ohio,' vol. ii, p. 324), "The fimbriated character of the posterior and lateral margins of the pygidium is very peculiar and hitherto unknown, I believe, in either of the above-mentioned genera" (*Phillipsia* and *Griffithides*), "though it occurs in one section (*Phaethon*) of the allied genus *Proetus;* hence, it is possible that our species should be called *Proetus* (*Phaethon*) *Lodiensis*, as it would not be very surprising that this genus should be found in this oldest member of the Carboniferous, though hitherto, I believe, only known in the Silurian and Devonian."[1]

The crenate character of the margin of the pygidium here alluded to must have been exceedingly slight in the typical specimen, as not a trace of it appears in the figure (pl. xviii, fig. 3). Prof. Meek says of this feature, "The segments are continued down upon and across the sloping border, at the edge of which they terminate in little pointed projections so as to present a fimbriated appearance around the posterior and lateral margins. (This latter character is not represented in the figure.)"

It is obvious from the terms here employed that the crenation alluded to in no wise resembles the pointed and almost spinous margin of the species described below. I may add that specimens of *Phillipsia Lodiensis* from the Cuyahoga shale of this county (Summit), only a few miles from the locality of Prof. Meek's type, show no perceptible crenation.

In regard to the two species of *Proetus* on the list given above, *P. ellipticus* and *P. auriculatus*, a few words may be added. I have not seen specimens of either, but the description of the former by its authors shows that it differs very slightly, almost imperceptibly, from *Phillipsia*. They remark in conclusion, "It is very probable that we should call this species *Phillipsia elliptica*, as it seems to present most of the characters of that genus. Unfortunately, the characters distinguishing these groups seem not to have been very clearly pointed out." ('Proc. Acad. Nat. Sci. Phil.', 1865, p. 267-8.)

The pygidium of *Proetus auriculatus*, Hall, is not certainly known. That which is supposed to belong to this species is "marked by seven or eight ribs

[2] In writing this sentence, 1875, Prof. Meek seems to have forgotten his own *Proetus ellipticus* of 1865, and Prof. Hall's *Proetus auriculatus* of 1861, the former from the Kinderhook, and the latter from the Waverley Sandstone.

terminating in a wide-spreading border." ('15th Report on State Cabinet of New York,' 1862, p. 107.)

In *Proetus Verneuili*, as figured by Prof. Hall in his Illustrations of Devonian Fossils (pl. xv, fig. 18), the lateral ribs extend partly across the border, forming a line of marginal tubercles, but there is no crenation of the edge. This is the nearest approach to the appearance described by Prof. Meek (loc. cit.) with which I am acquainted.

It follows, therefore, that with the single possible exception of *Phillipsia Lodiensis*, as described by Prof. Meek, no Trilobite has been announced from the American Carboniferous rocks in which the pleural ridges of the pygidium extend beyond the border. The occurrence, therefore, of the form (*Dalmanites? Cuyahogæ*) figured and described below (fig. 6) is of considerable interest to palæontologists. It was found in the Cuyahoga Shale, the uppermost member of the Lower Carboniferous system in Northern Ohio.

Fig. 4. *Griffithides globiceps*, De Kon. (twice nat. size).

5. *Phillipsia Derbiensis*, Martin (twice nat. size).

6. *Dalmanites? Cuyahogæ*, Claypole (twice nat. size).

7. *Phillipsia Lodiensis*, Meek (twice nat. size).

8. *Brachymetopus discors*, M'Coy. (five times nat. size).

Pygidia of species of Carboniferous Limestone Trilobites, *Griff. globiceps*, *Ph. Derbyensis*, *Ph. Lodiensis*, and *Brach. discors.*, compared with the pygidium of *Dalmanites Cuyahogæ*.

Dalmanites ? Cuyahogæ, Claypole. Geol. Mag., Decade iii, vol. i, p. 306, 1884. (Woodcut, Fig. 6.)

Head and thorax unknown. Pygidium about as broad as long, exclusive of the spinous processes to be mentioned below; distinctly trilobate. Middle lobe occupying a full third of the breadth, extending nearly to the hind extremity, distinctly separated by a furrow from the lateral lobes, and containing eleven or twelve ridges or partial rings. Lateral lobes as wide as the medial lobe, their segments or ribs produced for the most part about half their length beyond the marginal line formed by their union and ending in points, the third, seventh, and ninth produced to double the distance and having the appearance of spines. The third pair curve backward so that their points are level with the hind end of the pygidium. No marginal tract. Whole surface set with tubercles, of which there are five on each of the three parts of the first ring, the number gradually

diminishing toward the hind extremity; part of segment prolonged beyond the marginal line free from tubercles.

Horizon and Locality.—Cuyahoga Shale of Lower Carboniferous, Akron, Ohio.

It will of course be understood that the reference of the specimen to the genus *Dalmanites* is provisional only, and must await for confirmation the discovery of other parts of the carapace. I may add that since the above description was written I have found a second specimen and seen a third, both very imperfect, and only sufficient to support the statement of the existence of this type in the Lower Carboniferous rocks.

On Tomocaris Piercei, a recent Isopod, *dredged* East of Cape Frio, *by the late* Prof. L. Agassiz, *offering affinities with the* Trilobita.

The following letter, from the late Prof. Agassiz to Prof. Pierce, of Harvard College,[1] seems deserving of notice as recording the discovery of an abnormal form of existing Isopod, having many points of affinity with the extinct Trilobita.[2]

"In my first letter to you concerning deep-sea dredging, you may have noticed the paragraph concerning Crustacea in which it is stated that among these animals we may expect 'genera reminding us of some Amphipods and Isopods aping still more closely the Trilobites than *Serolis*.' A specimen answering fully to this statement has actually been dredged in forty-five fathoms, about forty miles east of Cape Frio. It is a most curious animal. At first sight it looks like an ordinary Isopod, with a broad, short, flat body. Tested by the characters assigned to the leading groups of Crustacea, whether we follow Milne Edwards' or Dana's classification, it can, however, be referred to no one of their orders or families. As I have not the works of the authors before me, I shall have to verify more carefully these statements hereafter; but I believe I can trust my first inspection. The general appearance of my new Crustacean is very like that of *Serolis*, with this marked difference, however, that the thoracic rings are much more numerous and the abdomen or pygidium is much smaller. It cannot be referred to the Podophthalmians of Milne Edwards (which correspond to the Decapods of Dana) because it has neither the structure of the mouth, nor the gills, nor the legs, nor the pedunculated eyes of this highest type of the Crustacea, nor can it be referred to the Tetradecopods of Dana (which embrace Milne Edwards' Amphipods and Isopods), because it has more than seven pairs of thoracic limbs; it cannot be referred to the Entomostraca, because the thoracic are all provided with locomotive appendages of the same kind. But it has a very striking resemblance to the Trilobites; it is, in fact, like the latter, one of those types combining the characteristic structural features of other independent groups which I have first distinguished under the name of synthetic types. Its resemblance to the Trilobites is unmistakable, and very striking. In the first place the head stands out distinct from the thoracic regions, as the buckler of

[1] 'Canadian Naturalist,' vol. vi, new series, 1872, p. 359.

[2] I am indebted to Mr. F. Beddard, Prosector of the Zoological Society of London, for calling my attention to *Tomocaris*. Mr. Beddard informs me he has written to Cambridge, U.S., to inquire about the specimen, but it has unfortunately been mislaid or lost, and no other has since been obtained.

Trilobites; and the large, kidney-shaped, faceted eyes recall those of Calymene; moreover, there is a facial suture across the cheeks, as in Trilobites, so that, were it not for the presence of the antennæ, which project from the lower side of the anterior margin of the buckler in two unequal pairs, these resemblances would amount to an absolute identity of structure. As it is, the presence of an hypostome in the same position as that piece of the mouth is found in Trilobites, renders the similarity of this extinct type of Crustacea still more striking, while the antennæ exhibit an unmistakable resemblance to the Isopods.

"In view of the synthetic character of these structural features it should not be overlooked that the buckler of our new Crustacean, for which I propose the name *Tomocaris Peircei*, extends sideways into a tapering point, curved backwards over the first thoracic ring, as is the case with a great many Trilobites. The thorax consists of nine rings, seven of which have prominent lateral points, curved backwards like the pleuræ of *Olenus*, *Lichas*, &c. The sixth ring is almost concealed between the fifth and seventh, and is destitute of lateral projections, as is also the ninth. Those rings are distinctly divided into three nearly equal lobes by a fold or bend on each side of the middle region, so that the thorax has the characteristic appearance of that of the Trilobites, to which the latter owes its name. The legs are very slender, and resemble more those of the Copepods and Ostracods than those of any other Crustacea. There are nine pairs of them, all alike in structure, six of which, however, the anterior ones, are larger than the three last, which are also more approximated to each other. Besides the legs there is a pair of maxillipeds attached to that part of the buckler which extends back to the facial suture. These maxillipeds resemble the claw of a Cyclops. All these appendages are inserted in that part of the rings corresponding to the bend of the thoracic lobes; so that if there exists a real affinity between the Trilobites and our little Crustacean—and their resemblance is not simply a case of analogy—we ought hereafter to look to a corresponding position for the insertion of the limbs of Trilobites. I do not remember with sufficient precision what Billings, Dana, and Verrill have lately published concerning the limbs of Trilobites to say now what bearing the facts described above may have upon the subject as lately discussed in 'The Journal of Science.' But of one thing I am satisfied, since I have examined the *Tomocaris Peircei* that Trilobites are not any more closely related to the Phyllopods than to any other Entomostracæ, or to the Isopoda. In reality the Trilobites are like *Tomocaris*, a synthetic type, in which structural features of the Tetradecapods are combined with characters of Entomostraca and other peculiarities essentially their own.

"The pygidium or abdomen of *Tomocaris* is very like the abdomen of the ordinary Isopods with an articulated oar attached sideways, and leaf-like respiratory organs upon the under side. The whole pygidium is embraced

between the last curved points of the side of the thorax. Owing to these various combinations I would expect in Trilobites phyllopod-like respiratory appendages under the pygidium only, and slender, articulated legs, with lateral bristles under the thorax, so thin and articulated by so narrow a joint as easily to break off without leaving more than a puncture as an indication of their former presence. It is impossible to study carefully the synthetic types without casting a side glance at those natural groups, which, without being strictly synthetic themselves, have nevertheless characters capable of throwing light upon the whole subject. And in this connection I would say a few words of *Apus* and *Limulus*. If I remember rightly, Milne Edwards considers the shield of *Limulus* as a cephalothorax in which the function of chewing is devolved upon the legs, while he regards the middle region as an abdomen, and the sword-like tail as an appendage *sui generis*. In the light of what proceeds I am rather inclined to consider the cephalic shield of *Limulus* as a buckler homologous to that of the Trilobites, and the middle region as a thorax in which the rings show unquestionably signs of a division into lobes as in Trilobites. The tail would then answer to the pygidium. *Apus* should be compared with the other Crustacea, upon the same assumption as *Limulus*.

L. AGASSIZ."

" *Rio, on board the* ' *Hassler*,'
" *Feb.* 12*th*, 1872.

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I. *Phillipsia Derbiensis.*

II. *Phillipsia Colei.*

III. *Phillipsia gemmulifera* and *Phillipsia truncatula.*

IV. *Phillipsia Eichwaldi* and *Ph. Eichwaldi* var. *mucronata.*

V. *Griffithides seminiferus.*

VI. *Griffithides globiceps, acanthiceps, longiceps, obsoletus,* and *platyceps.*

VII. *Phillipsia quadrilimba, laticaudata, Griffithides acanthiceps, longispinus, brevispinus, moriceps,* and *calcaratus.*

VIII. *Brachymetopus ouralicus, Maccoyi, discors, hibernicus,* and *Griffithides seminiferus.*

IX. *Griffithides acanthiceps, globiceps, longispinus, glaber, Carringtonensis,* and *Phillipsia scabra* and *carinata. Serolis paradoxa* and *Sphæroma gigas* (recent).

X. *Phillipsia Leei, minor, Cliffordi,* and *articulosa.*

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PLATE VII.

Carboniferous Trilobites.

Fig. 1.—*Phillipsia quadrilimba*, Phil., sp. Pygidium. (Figure reproduced from Phillips' 'Geology of Yorkshire,' 1836, vol. ii, pl. xxii, fig. 2, p. 239.) Bolland, Yorkshire. (P. 26.)

Fig. 2.—*Griffithides acanthiceps*, H. Woodw. Nearly complete example, from Craco, near Grassington, Yorkshire. (P. 32.)

The original specimen in the cabinet of J. Aitken, Esq., Sandfield, Urmston, Manchester.

Fig. 3.—*Griffithides acanthiceps*.—Showing a detached head and pygidium from Settle, Yorkshire. (P. 33.)

The original specimen in the Woodwardian Museum, Cambridge.

Fig. 4.—*Phillipsia laticaudata*, H. Woodw. A detached glabella and pygidium from Bolland, Yorkshire. (P. 42.)

The original specimen in the Geological Department, British Museum (Natural History.)

Figs. 5 *a*, *b*, *c*, and 6.—*Griffithides longispinus*, Portl.—5 *a*, profile; 5 *b*, front view of head; 5 *c*, view of pygidium of a rolled-up example (being the type-specimen figured by Portlock in his 'Geology of Londonderry and Tyrone,' pl. xxiv, fig. 12); 6, restoration of same unrolled. From Carnteel, Tyrone, Ireland. (P. 36.)

The original specimen in the Museum Practical Geology, Jermyn Street.

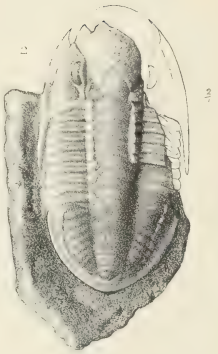
Figs 7 and 8.—*Griffithides brevispinus*, H. Woodw. Portions of two heads. From Langside, Beith, Ayrshire. (P. 39.)

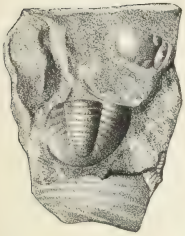
Original specimens in the collection of Mr. Robert Craig, Langside, Beith.

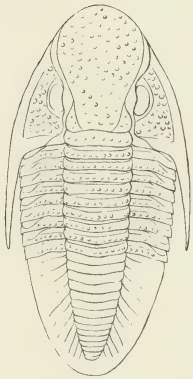
Figs. 9, 10, 11, and 12.—*Griffithides moriceps*, H. Woodw. The heads only preserved. From Settle, Yorkshire. (P. 39.)

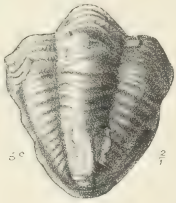
Original specimens in the Woodwardian Museum, Cambridge.

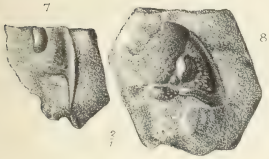
Fig. 13.—*Griffithides calcaratus*, M'Coy. Copied from Prof. M'Coy's figure in 'Synopsis Carbonif. Fossils of Ireland,' 1844, pl. iv, fig. 3. Roughan, Dungannon, Ireland. (P. 38.)

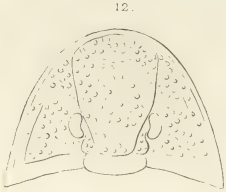


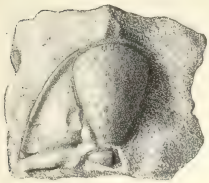












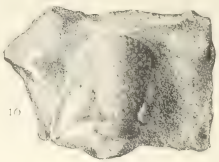


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PLATE VIII.

Carboniferous Trilobites.

Figs. 1—8.—*Brachymetopus ouralicus*, De Verneuil, sp., 1845. (P. 48.)

Fig. 1.—Head-shield, having both eyes perfect; enlarged four times natural size; from the Carboniferous Limestone, Settle, Yorkshire.

Original specimen in the Woodwardian Museum, Cambridge.

Fig. 2.—Another specimen, right eye wanting; neck-lobe well seen; enlarged four times natural size; from same locality and formation as preceding.

Original in the British Museum (Natural History) Cromwell Road.

Fig. 3.—A somewhat larger head-shield, enlarged three times natural size, having one of the cheek-spines perfect, but wanting the eyes; from the same locality and collection as Fig. 1.

Figs. 4 and 5.—Two specimens, both with their head-shield and pygidium preserved close together, each in its own piece of matrix; enlarged twice the natural size; from the same locality, formation, and collection as figs. 1 and 3.

Fig. 6.—A very large pygidium, nearly perfect; magnified twice the natural size; from the same locality and collection as figs. 1, 2, 4, and 5.

Fig. 8.—Another pygidium, enlarged twice natural size; from the Carboniferous Limestone near Cork.

The original specimen in the collection of Joseph Wright, Esq., F.G.S., of Belfast.

Fig. 7.—Outline figure of *Brachymetopus ouralicus* restored and enlarged.

Figs. 9—13.—Brachymetopus Maccoyi, Portlock, sp. (P. 52.)

Fig. 9.—A pygidium, enlarged three times, from the Black Carboniferous Limestone, Monaster.

The original specimen in the collection of Joseph Wright, Esq., F.G.S., of Belfast.

Fig. 10.—Head-shield of same from the same locality and collection as the above; enlarged three times.

Fig. 11.—Another head-shield of same, showing anterior margin of head well preserved, enlarged three times; from the Lower Limestone Shale (Carboniferous Limestone), County Limerick.

Original specimen in the Museum of the Geological Survey of Ireland, Dublin.

Fig. 12.—Head-shield having both cheek-spines preserved; enlarged three times natural size; from the same locality and collection as figs. 9 and 10.

Fig. 13.—Outline figure. Restored and enlarged of *B. Maccoyi*.

Fig. 14.—Pygidium, probably of *Griffithides seminiferus* (see Pl. V), from the Carboniferous Limestone, Settle, Yorkshire. (P. 28.)

Original specimen in the Woodwardian Museum, enlarged twice the natural size.

Fig. 15.—*Brachymetopus discors*, M'Coy. Pygidium, magnified six times, from the Carboniferous Limestone, Little Island, Cork. (P. 54.)

Original specimen from the collection of Joseph Wright, Esq., F.G.S., Belfast.

Fig. 16.—*Brachymetopus hibernicus*, H. Woodw., sp. Pygidium enlarged twice the natural size. From the Carboniferous Limestone, Kildare, Ireland. (P. 55.)

The original specimen in the British Museum (Natural History), Cromwell Road.

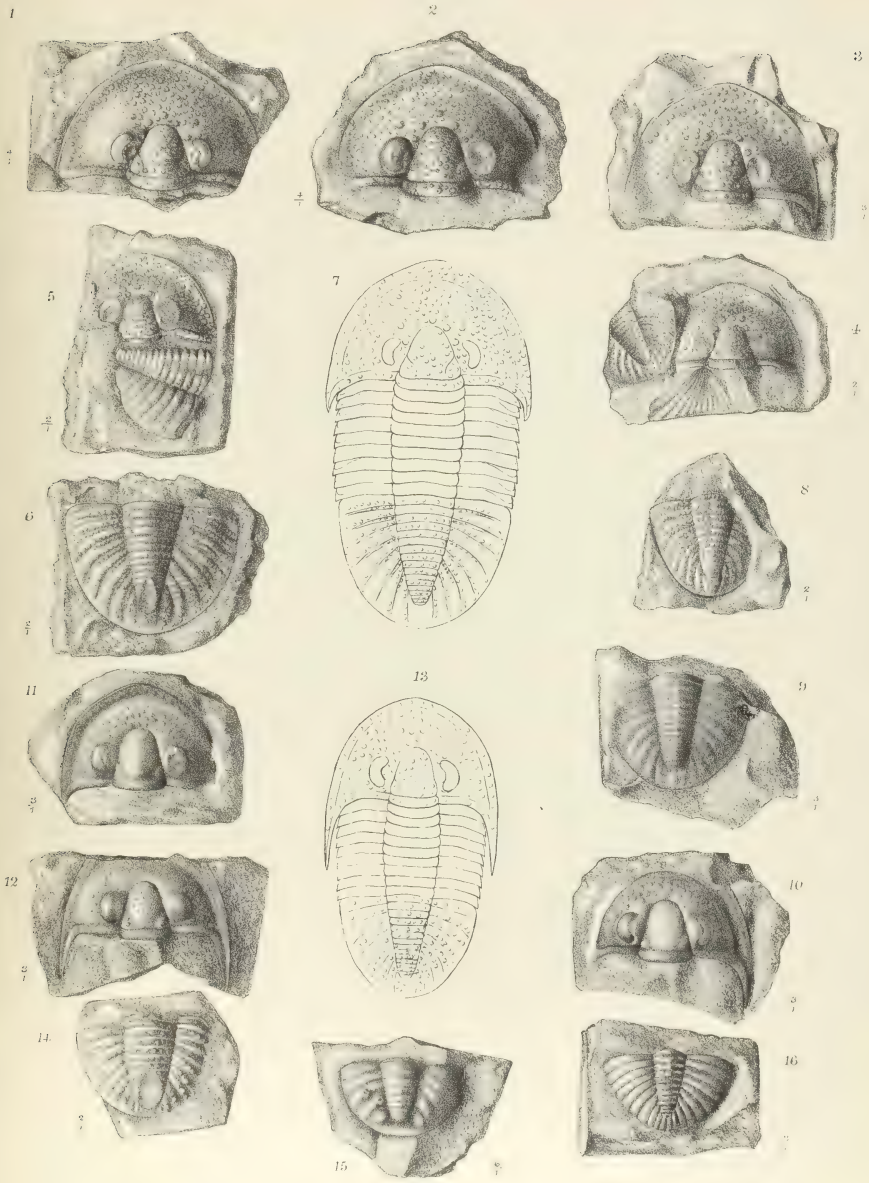

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PLATE IX.

Carboniferous Trilobites and Recent Isopoda.

Fig. 1.—*Griffithides acanthiceps*, H. Woodw. Restoration in outline. (P. 32.) See Pl. VI, figs. 2, 10, and 11, and Pl. VII, figs. 2 and 3.

Fig. 2.—*Griffithides globiceps*, Phill., sp. Restoration in outline. (P. 29.) See Pl. VI, figs. 1, 3, 4, 5, and 6.

Fig. 3.—*Griffithides longispinus*, Portl. Glabella and hypostome (*h*), the former showing the preocular pore (*p*). Longnor, Derbyshire. See Pl. VII, figs. 5 and 6. (Pp. 36, 42.)

The original specimen in the Museum of Practical Geology.

Figs. 4 *a* and *b*.—*Griffithides glaber*, H. Woodw. 4 *a*, nearly entire specimen, enlarged twice nat. size; 4 *b*, body segments and tail, enlarged twice nat. size. From Castle Mumbles, Glamorganshire. (P. 40.)

The original specimens in the Museum of Practical Geology.

Figs. 5 *a* and *b*.—*Phillipsia scabra*, H. Woodw. 5 *a*, head-shield or cephalon, enlarged three times nat. size; 5 *b*, pygidium or abdomen, enlarged three times nat. size. From Vallis Vale, Frome, Somerset. (P. 43.)

The original specimens in the Museum of Practical Geology.

Figs. 6 *a* and *b*.—*Griffithides? Carringtonensis*, Eth. MS. Two pygidia, enlarged three times nat. size. 6 *a*, Longnor, Derbyshire; 6 *b*, Narrowdale. (P. 41.)

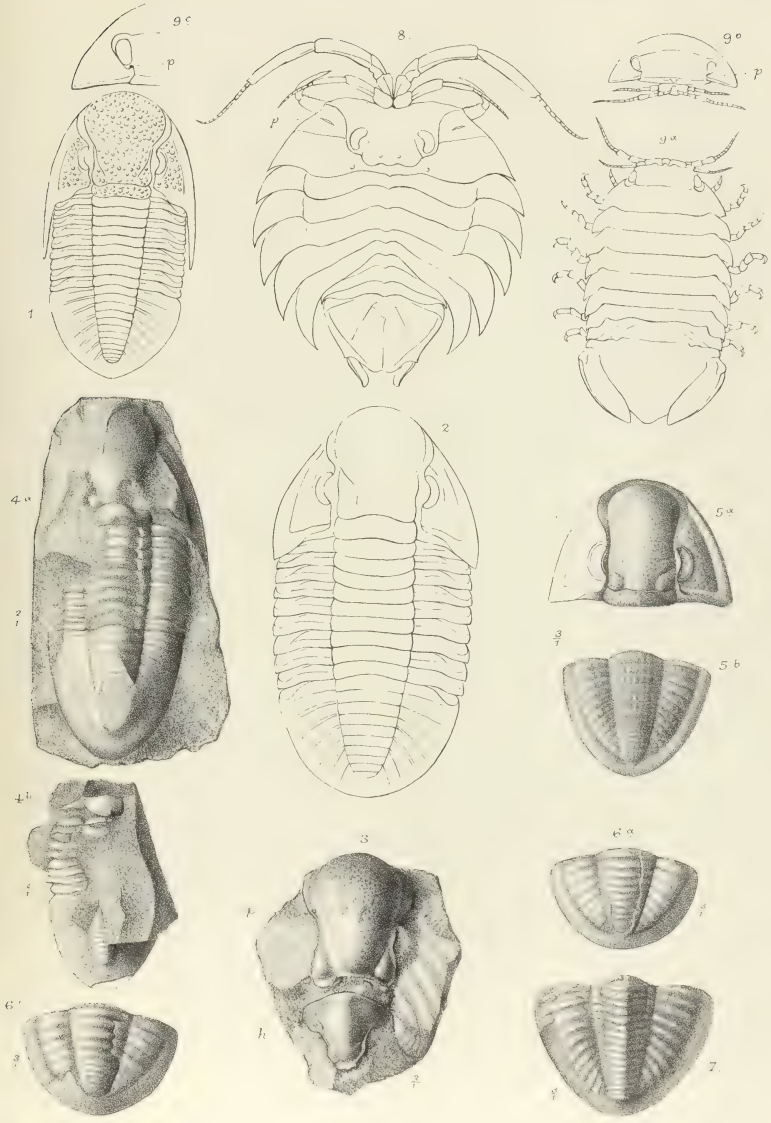
The original specimens in the Museum of Practical Geology.

Fig. 7.—*Phillipsia carinata*, Salter, MS. Pygidium, enlarged three times nat. size. From the Carboniferous Limestone, Derbyshire. (P. 44.)

The original specimen in the Museum of Practical Geology.

Fig. 8.—*Serolis paradoxa* (recent). Enlarged one and a half nat. size. From Sandy Point, Straits of Magellan. Showing the pore (*p*) near the margin of the first thoracic somite. (See Appendix, p. 76.)

Fig. 9 *a*, *b*, *c*.—*Sphæroma gigas* (recent). Twice nat. size. From Kerguelen's Island. 9 *b*, front view of the head, showing pore (*p*); 9 *c*, half of same, enlarged four times, to show the pore more distinctly (*p*). (See Appendix, p. 76.)



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EXPLANATION OF PLATE X.

Figs. 1—4.—*Phillipsia Leei*, H. Woodw., sp. nov. Lower (Carboniferous) Culm-shales, Waddon-Barton, near Chudleigh, Devonshire. (P. 66.)

Fig. 1.—Head-shield with part of the pygidium seen. The thoracic segments appear to underlie the head, and to be squeezed against the carapace beneath. Specimen enlarged three times.

Fig. 2.—Head-shield with five thoracic segments still united; also a detached pygidium. Enlarged three times.

Fig. 3.—A third head-shield with the left eye fairly preserved, showing also the facial sutures and the oblique furrows on the glabella. Enlarged three times.

Fig. 4.—Another head showing trace of the eye, and the facial suture and basal lobe of the glabella; also part of thoracic segments. Enlarged four times.

Figs. 5, 6 *a*, *b*—8, 8 *a*.—*Phillipsia minor*, H. Woodw., sp. nov. Formation and locality the same as that of the preceding species. (P. 68.)

Fig. 5.—A pygidium seen in intaglio. Enlarged four times.

Fig. 6 *a* and *b* only.—*a*. Head-shield; and *b*, pygidium of same. Enlarged three times natural size.

Fig. 7 *a*.—A nearly entire example, seen in intaglio, enlarged eight times natural size, with one detached free-cheek (*c*) and hypostome (*h*).

Fig. 8 *a* only.—A small detached head. Enlarged three times natural size.

Fig. 8 *b*, and figs. 9—12.—*Phillipsia Cliffordi*, H. Woodw., sp. nov. Formation and locality the same as that of the preceding species. (P. 69.)

Fig. 8 *b* only.—Pygidium. Enlarged three times.

Figs. 9 and 10.—Pygidia. do.

Fig. 11.—Portion of a head-shield showing the right side of the glabella with the free-cheek attached, and a detached pygidium. Enlarged four times.

Fig. 12.—A detached pygidium. Enlarged eight times.

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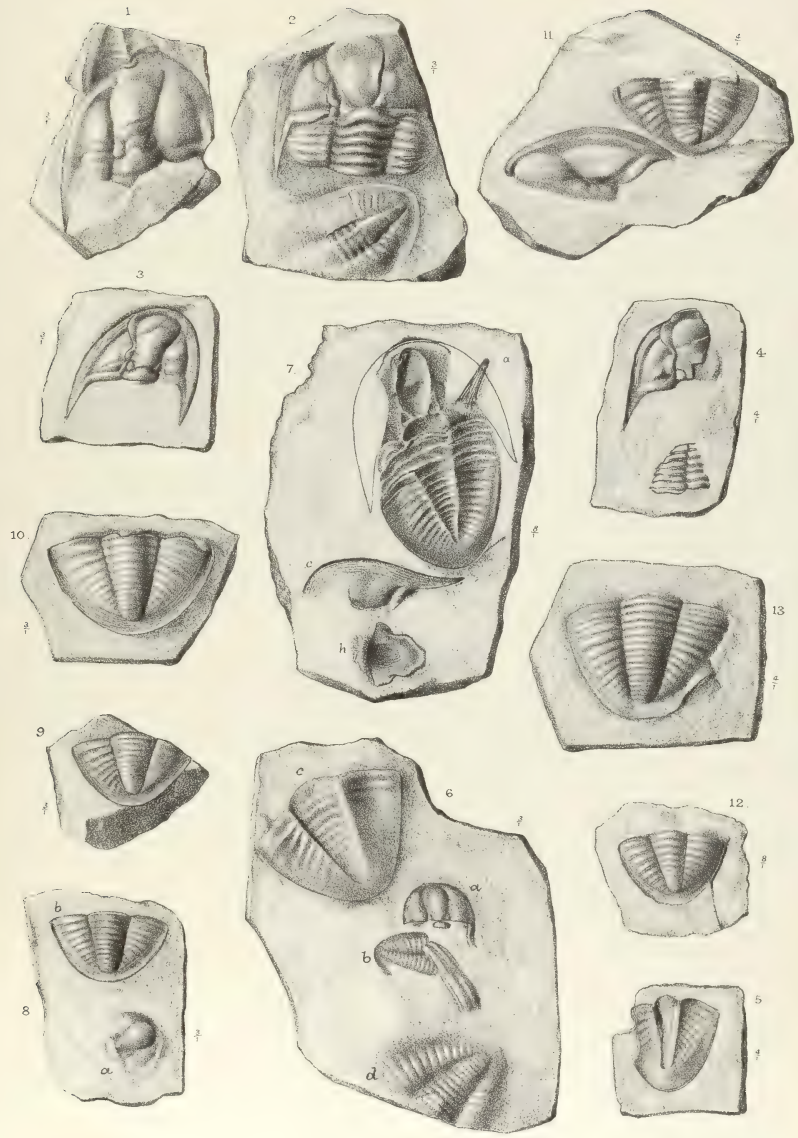
Fig. 6.—Two pygidia (*c*) seen from beneath, (*d*) seen from above. Enlarged three times natural size.

Fig. 13.—Detached pygidium. Enlarged four times.



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MDCCCLXXXIV.

A MONOGRAPH

OF THE

BRITISH FOSSIL BRACHIOPODA.

BY

THOMAS DAVIDSON, LL.D., F.R.S., F.L.S., F.G.S.,

VICE-PRESIDENT OF THE PALÆONTOGRAPHICAL SOCIETY; MEMBER OF THE GEOLOGICAL SOCIETIES OF FRANCE, BELGIUM, EDINBURGH, GLASGOW, AND OF CORNWALL; FOREIGN MEMBER OF THE PROVINCIAL INSTITUTE OF FRANCE; OF THE LINNEAN SOCIETY OF NORMANDY; CORRESPONDING MEMBER OF THE IMPERIAL ACADEMY OF SCIENCES OF ST. PETERSBURG; OF THE IMPERIAL MINERALOGICAL SOCIETY OF ST. PETERSBURG; OF THE IMPERIAL SOCIETY OF NATURALISTS OF MOSCOW; OF THE ROYAL ACADEMIES OF BELGIUM AND BAVARIA; OF THE ROYAL SOCIETY OF HOLLAND, HAARLEM; OF THE ROYAL SOCIETY OF LIÈGE; OF THE ACADEMY OF ST. LOUIS; OF THE AMERICAN PHILOSOPHICAL SOCIETY, PHILADELPHIA; OF THE INSTITUTE OF ALBANY, UNITED STATES; OF THE ZOOLOGICAL SOCIETY OF VIENNA; OF THE PALÆONTOGRAPHICAL SOCIETIES OF BELGIUM AND OF SWITZERLAND; OF THE MALACOLOGICAL SOCIETY OF BELGIUM; HON. MEMBER OF THE GEOLOGISTS' ASSOCIATION, LONDON; OF THE DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY; OF THE NATURAL HISTORY SOCIETY OF GLASGOW; AND OF THE YORKSHIRE PHILOSOPHICAL SOCIETY, ETC. ETC.

VOL. V.

PART III.

APPENDIX TO SUPPLEMENT, GENERAL SUMMARY, WITH CATALOGUE AND INDEX OF THE BRITISH SPECIES.

PAGES 243—476; PLATES XVIII—XXI.

WITH TITLE-PAGE TO VOL. V AND DIRECTIONS TO THE BINDER.

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BRITISH FOSSIL BRACHIOPODA.

DIRECTIONS TO THE BINDER.

The Monograph on the Fossil Brachiopoda of the Devonian and Silurian Supplements will be found in the publications of the Palæontographical Society issued for the years 1882, 1883, and 1884.

Cancel the title-pages of the separate parts in the volumes for the years 1882, 1883, and 1884, (dated 1882, 1883, and 1884) and *substitute* the general title-page (dated 1882—1884) now provided, and follow the order of binding given in the accompanying table of pages, plates, and dates.

ORDER OF BINDING AND DATES OF PUBLICATION OF VOLUME V.

	PAGES	PLATES	ISSUED IN VOL. FOR YEAR	PUBLISHED
Part III	Title-page "1882—1884"		1884	December, 1884
Part I	1—134	I—VII	1882	June, 1882
Part II	135—242	VIII—XVII	1883	October, 1883
Part III	243—476	XVIII—XXI	1884	December, 1884

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APPENDIX TO THE SUPPLEMENTS.

It will now be desirable to notice a few Cretaceous, Jurassic, Carboniferous, and Devonian Brachiopoda that have been discovered subsequent to the publication of the Supplements relating to the species from those formations.

CRETACEOUS.

1. Terebratula ovoides, *Sow.* Dav., Drift Sup., Vol. IV, Pl. I, figs. 12, 13.

In Vol. IV, p. 10, of my Drift Supplement, I referred to this species as having been found by Sowerby "in a sandstone containing green sand," since then, at p. 154 of his valuable Essay on the Neocomian Fossils of England,[1] Mr. W. Keeping says, while describing *T. ovoides*, that it is "a species to which much doubt and considerable interest attaches on account of its wide distribution in boulders, while it is unknown *in sitú*. It is a large species, with a very characteristic mesial ridge along the large valve, and with the dorsal valve frequently flattened in the specimens from Upware, South Willingham, and Herrimere. . . . . I have found it in a hard green-grey sandstone boulder at South Willingham, in Lincolnshire, also at West Dereham, near Downham Market. But its most interesting occurrence is at Herrimere, north of Upware, on the Cam, for here it occurs associated with other fossils whose age can be determined, namely, Lower Cretaceous. I have already given my reasons for believing that this occurrence at Herrimere is not *in sitú* as has been stated elsewhere ('Geol. Mag.,' 1870), nor of Jurassic age, but that it is really in a boulder of Neocomian Sandstone."

2. Terebrirostra lyra, *Sow.*, sp. Dav., Cret. Mon., Pl. III, figs. 17—28. Appendix to Sups., Vol. V, Pl. XVIII, figs. 1, 1*a*, 2.

Since describing this fine species at p. 32 of my 'Cretaceous Monograph' the British Museum has acquired Mr. Cunnington's fine collection of Horningsham Upper

[1] The Fossils and palæontological affinities of the Neocomian deposits of Upware and Brickhill, Cambridge, 1883 (Sedgwick Prize Essay for 1879).

Greensand fossils. Among the specimens is an example of *T. lyra*, measuring 2 inches 7 lines in length by 1 inch in breadth and depth. It is the largest specimen of the species that has hitherto come under my notice.

3. Terebratulina gracilis, *Schlotheim.* Dav., Cret. Mon., Pl. II, figs. 13, 14 (not 15, 16, 17).

When describing this species at p. 38 of my Cret. Monograph I placed *Terebratula rigida*, Sow. ('Min. Con.,' tab. dxxxvi, fig. 2), among the supposed synonyms of Schlotheim's species. Subsequently, as stated at p. 31 of my 'Cretaceous Supplement,' Dr. Schloenbach insisted that the shell to which Sowerby had given the name of *Terebratula rigida* was specifically distinct from *T. gracilis*, and he referred the small *Terebratulina*, which is so abundant in the Cambridge Greensand, to Sowerby's *T. rigida*.

Sowerby describes his *T. rigida* as "orbicular, plaited; plaits granulated, increasing towards the margin; lesser valve nearly flat, the outer convex with a small beak," and adds, "a well-defined species, with an even front and small circular opening in the beak. Only one specimen of this little shell has come within my observation, it was found in the Chalk near Norwich." The Cambridge Upper-Green sand shell has never to my knowledge been met with in the Norwich Chalk.

In shape and dimensions, as well as in stratigraphical position, Sowerby's *T. rigida* in no way resembles the little, sometimes so named, *Terebratulina* that occurs in such great abundance in the Upper Greensand near Cambridge. The *T. rigida* of Sowerby, from the Chalk of Norwich, seems to be a rare shell, as it has never come under my notice; and its figure is oval or orbicular, while the Cambridge shell is broadly triangular, and had better have a separate name.

In the Appendix to W. H. Penning and Jukes-Brown's 'Memoir on the Geology of the Neighbourhood of Cambridge' ('Memoirs of the Geol. Survey),' p. 147, pls. 13 and 14, 1881, Mr. R. Etheridge describes two specimens from the Middle Chalk and from the Totternhoe stone of Cherry Hinton and Burnel, near Cambridge, by the varietal names of *Terebratulina gracilis*, var. *lata*, and *Terebratulina gracilis*, var. *nodulosa*, but I am not quite satisfied that either are strictly speaking varieties of Schlotheim's true *Terebratulina gracilis*. More specimens will have to be examined before the question mooted can be solved.

4. Terebratulina triangularis, *Etheridge*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 3, 3 *a*, *b*.

Terebratula striata, var. triangularis, *Etheridge*. Appendix to W. H. Penning and Jukes-Brown's Memoir on the Geology of the Neighbourhood of Cambridge, p. 148, pl. iii, fig. 15, 1881.

Shell small, somewhat triangular, anteriorly broadly rounded, tapering posteriorly; hinge-line less than half the breadth of the shell; dorsal valve very moderately convex, sometimes more or less flattened, and slightly depressed along the middle; auricles on either side of the umbonal beak well defined. Ventral valve more convex and deeper than the opposite one; beak very little incurved; foramen comparatively large; deltidial plates small; beak-ridges well defined, and leaving between them and the hinge-line a small flattened space. Surface of valves covered with a variable number of radiating ribs, with one or two shorter riblets interpolated between the longer ones. Surface of valves crossed by concentric lines of growth.

Length and breadth 3, depth $1\frac{1}{2}$ lines.

Obs.—This is the shell that occurs by thousands in the Upper Greensand in the neighbourhood of Cambridge, and to which the name of *T. rigida* has been sometimes applied. It is described by Etheridge as a variety of *Terebratulina striata*, but I differ with my friend in this particular, and believe it more nearly allied to *Terebratulina gracilis* than to *T. striata*. It seems to be a well-marked species. If the name of *triangularis* has not already been applied to some other species of the genus, I would gladly adopt it for the little Upper-Greensand shell as something definite.

Unfortunately the plates and figures of Brachiopoda in the Appendix to the 'Geology of the Neighbourhood of Cambridge' are so indefinite or badly drawn that they are useless for purposes of identification, so that I have figured this shell after Mr. Etheridge's specimen, kindly lent me for this purpose, out of the Museum of Practical Geology. I question whether Mr. Etheridge's *Terebratulina gracilis*, var. *nodulosa*, is specifically separable from the shell under description.

5. Terebratella Keepingii, *Walker*, MS. Dav., Appendix to Supplements, Pl. XVIII, figs. 4, 4*a*, 5.

Terebratella Keepingii (*Walker*), *W. Keeping*. The Fossils and palæontological affinities of the Neocomian Deposits of Upware and Brickhill, Cambridge, p. 130, pl. vii, fig. 19, 1883.

Shell sub-pentagonal, longer than wide, tapering posteriorly, broadest at its anterior half, truncate or slightly rounded in front. Dorsal valve moderately convex, ventral valve deeper and more convex than the dorsal one; beak produced, very slightly incurved, and truncated by a small foramen margined anteriorly by an elongated deltidium in two pieces. Lateral portions of the valves often much thickened. Surface of valves covered with delicate radiating riblets, increasing in number at intervals by the interpolation of shorter ribs. Two specimens measured respectively—

Length 12, breadth 9, depth 5 lines.

Length 11, breadth $6\frac{1}{2}$ lines.

Obs.—In his description of this fossil Mr. W. Keeping says: "This shell varies considerably; the typical shell is pentagonal in form, but some specimens have the long sac-like shape of *T. digona*; they vary also in the length of the shell and coarseness of striation; the latter is, however, always much more delicate than in *T. Davidsoni*. The last-named species is the nearest ally of *T. Keepingii*, and is the only one with which it could be confounded. Our new species is distinguished by its greater length, especially length of beak and area, its steep sides, truncated front, and delicate striæ. It is an extremely well-marked type, although, as I have shown elsewhere, the passage forms have been found connecting it with *T. Davidsoni*."

I am myself strongly impressed with the idea that *T. Keepingii* is only a variety of *T. Davidsoni*, but as Mr. Keeping has seen a much larger series of both species I am willing provisionally to keep both forms separate.

Middle Neocomian, Brickhill, Bedfordshire.

6. Kingena ? rhomboidalis, *W. Keeping*. Dav., Appendix to the Supplements, Vol. V, Pl. XVIII, fig. 10, 10 *a*, *b*.

Megerlia (Kingena) rhomboidalis, *Keeping*. The Fossils and palæontological affinities of the Neocomian Deposits of Upware and Brickhill, Cambridge, p. 128, pl. vii, fig. 3, 1883.

"Shell rhomboidal, slightly longer than broad, moderately convex, thickest near the beaks, surface smooth, shell structure coarsely punctate. Dorsal valve obtusely trigonal, convex, especially near the beak. Hinge-line gently curved; front obtusely pointed. A distinct line extending three quarters the length of the shell indicates the internal dorsal septum of the genus. Ventral valve rhomboidal, obscurely keeled from back to front. Beak sharp, beak ridges acute, area elongated, flattened, and concave, deltidium in two pieces; foramen small. Length $9\frac{1}{2}$ mm., breadth 9 mm." (Keeping.)

Obs.—I have seen only one specimen of this shell, the type in the Woodwardian

Museum, Cambridge. It was procured from the Middle-Neocomian Sands at Brickhill in Bedfordshire. Mr. Keeping adds to the foregoing description that it is "characterised by its rhomboidal form. In Britain we have only *K. lima*, Defrance, to distinguish it from a species to which it bears considerable resemblance; but the front margin in *K. lima* is truncated, whilst in *K. rhomboidalis* it is obscurely pointed; in our new species the beak is less incurved. The hinge-line is, as a rule, more curved, and the dorsal valve is more swollen than in *K. lima*; also this latter species is ornamented with 'small granulations, or short, hollowed spines,' which I have not found in *K. rhomboidalis*. Again, the lines of growth are more marked. In geological times the two species seem always to have been separated, *K. lima* ranging only from the Gault to the Chalk." A search for more specimens would be desirable.

7. Terebratella Menardi, *Lamarck*. Dav., Cret. Mon., Pl. III, figs. 34—42; Appendix to Supplements, Vol. V, Pl. XVIII, fig. 6.

This appears to be a very rare fossil in the Middle Neocomian at Upware in Cambridgeshire. A single example of it was found by Mr. E. Towry Whyte, and presented by him to the Woodwardian Museum, Cambridge.

8. Waldheimia Bonneyi, *W. Keeping*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 9, 9 *a*, *b*.

Waldheimia Bonneyi, *W. Keeping*. The Fossils and palæontological affinities of the Neocomian Deposits of Upware and Brickhill, p. 129, pl. vii, fig. 4, 1883.

Shell subpentagonal, longer than wide, broadest about the middle; sides rounded, tapering posteriorly, slightly indented anteriorly; valves nearly equal, convex, with a longitudinal median depression in each valve, commencing at about one third of the length of the valve from the beak and gradually widening as it nears the front; beak moderately incurved and truncated by a circular foramen, completed or margined by small deltidial plates; surface smooth, marked by concentric lines of growth; loop long and reflected.

Length 1 inch 2 lines, breadth 11, depth 9 lines.

Obs.—In his description Mr. H. Keeping says: "This species varies considerably in its form, much in the same way as does its near ally *W. pseudo-jurensis*. Some of the specimens are flattened so as to pass into that species by regular gradation, but the

typical ones are always more inflated. The less truncated forms approach *W. Wanklyni*. Some specimens are much thickened on the front margin, some are broadly truncated in front, and others are almost pointed."

Locality.—Upper Greensand or Middle Neocomian. Little Brickhill two and a half miles east of Blatchley, Bedfordshire.

At the period at which I published my Cretaceous Monograph and its Supplement, the Brickhill locality and its fossils had not been discovered. It was subsequently described by Mr. Keeping in the 'Geological Magazine,' decade ii, vol. ii, August, 1875, and more fully by the same author in his instructive and valuable 'Sedgwick Prize Essay for the year 1879,' above referred to, and from which we extract (p. 20) the following important remarks:

"Both the Upware and Brickhill Neocomian sea-bottoms were particularly rich in the 'lamp-shells.' They grew so thickly clustered together in places that, being overcrowded, they interfered with each other's proper growth and produced abnormal distortions." (Mr. Walker possesses a specimen of *Ter. Meyeri* in which the irritation produced by the working of a boring shell has caused a pearl to be formed in its interior.) "Brickhill was the metropolis of the Brachiopoda in Cretaceous times; but still, although the species are so numerous (thirty-five in all), the genera are few, namely, only *Terebratula*, *Waldheimia*, *Terebratella*, *Kingena* (1 sp.), *Terebratulina* (1 sp.), and *Rhynchonella*. Amongst these the *Waldheimia Woodwardi* and *W. pseudo-jurensis*, and the species of *Terebratella*, are the most noteworthy, as remarkable and characteristic types. Of the *Terebratellæ* only two species, *T. Meyeri* (n. sp.) and *T. Davidsoni*, are common at Upware; no well-marked representative of the other species having to my knowledge occurred in that neighbourhood. *Terebratula capillata* is remarkable on account of its limited and curious distribution, being only known in these Neocomians, the Red Chalk, and the Tourtia of Belgium. *Terebratula Upwarensis*, *T. microtrema*, *T. prælonga*, *T. depressa*, and *T. Moutoniana* were extremely abundant, but *T. Meyeri*, *T. Lancasteri*, and *T. Dallasii* are rare. At Brickhill the Brachiopods occurred in the richest profusion, and a noble series of them may be studied in the Woodwardian Museum. The near relationship of the Brickhill species to the Upware group is incontestable, all the Upware species, except *Waldheimia Woodwardi*, *Terebratella Meyeri*, and *T. capillata*, having been found here also. The most noteworthy points of difference are the much greater development of the *Terebratulæ* at Brickhill (*T. Keepingii* is unknown elsewhere), the presence of *Kingena rhomboidea* and *Terebratulina striata*, and the absence of the species aforementioned. It may be observed that these Brickhill species, absent from Upware, are more southern forms, known at Faringdon, or in the Wealden area at Godalming and Hythe. . . .

"It is a matter of general experience in working amongst the more prolific families and genera of organic types, that the boundaries of our recognised species are found to be most shadowy and evanescent. In any particular species we have the well-marked

typical specimens, but we also meet with a number of 'intermediate forms,' specimens 'not well marked,' with the specific characters ill-defined, and approaching an allied type. Unfortunately these specimens are, as a rule, rejected by collectors as troublesome and unworkable, and are therefore stowed away in boxes amongst the duplicates and lost sight of. This is a most regretable custom, by which we have already lost a mass of valuable material. The value of the work of separation of species and the discrimination of their special characteristics are not likely to be underrated by the geologist and naturalist, but the discovery of their relations to one another and the determination of the positions they have occupied in the development of the great life-groups is likewise a noble work, and a work not only of profound interest to the biologist, but one that we may also hope to be of great value even to the geologist in determining the relative ages of rock-beds.

"The acquisition of large numbers of Brachiopods from the rich collecting-grounds of Upware and Brickhill has furnished us with unusually good opportunities for working out the meaning of these variations amongst the species of *Terebratula*, &c. At Upware many of the species are well defined, as *Terebratula Upwarensis, Waldheimia Woodwardi, Terebratella Meyeri*, and *Terebratella Davidsoni*; but some species are so freely connected that an ordinary small collection cannot, to our satisfaction, be completely separated out into its several species. Such are, for example, *Terebratula depressa, T. prælonga*, and *T. microtrema*. But it is at Brickhill that these intermediate forms are most conspicuous and important; from this locality the Woodwardian Museum has accumulated upwards of 15,000 specimens of Brachiopoda, and from these I have selected a series of specimens and arranged them upon tablets, to show the relations of the species to one another, as shown by intermediate connecting forms in the following manner:

"*Genus*—TEREBRATULA.

"*Terebratula Cantabrigiensis*, Walker.

↓

— *depressa* { →*cyrta*, Walker. / →*uniplicata*, Walker.

↓

— *Seeleyi*, Walker.

↓

— *prælonga*, Sow. { →*Dallasii*, Walker. / →*Lankesteri*, Walker.

↓

— *microtrema*, Walker. { →*extensa*, Meyer. / ...*Meyeri*, Walker.

⋮

— *Moutoniana*, d'Archiac.

⋮

— *sella*, Sow.

↓

— *Tornasensis*, d'Archiac.

↓

— *Upwarensis*, Walker.

"The arrows indicate the lines of variations and probable development. The dotted signs signify the less perfect continuity and connection."

Mr. Keeping has treated in a similar manner the species of *Waldheimia* and of *Terebratella*, but has not attempted to grapple similarly with the perplexing group of *Rhynchonella*. He connects by an arrow *Waldheimia Celtica* (Morris), *W. Wanklyni*, var. *angusta* (Walker), *W. Wanklyni*, var. *elliptica* (Walker), *W. faba*, d'Orb. (?), *W. pseudo-jurensis*, Leymrie ⋙⟶ many varieties. New species, *W. Hughesii*, Keeping, by dots, *W. tamarindus*, Sow., and *W. Juddii*, Walker, and adds that the species of the *oblonga* group of *Terebratella* fall into line with perfect ease in the order indicated in the following table (p. 24) :

TEREBRATELLA.—*Group A.*

Terebratula Keepingii, Walker.
↓
— *Davidsoni*, Walker.
↓
— *oblonga*, Sow.
↓
— *Meyeri*, Keeping.
↓
— *Fittoni*, Meÿer.

He states also that of the straight-hinged types of *Terebratella*, transition forms occur binding together the two so-termed species *T. Menardi* and *T. trifida*, but that at Upware and Brickhill no traces of any passage of the two types *oblonga* and *Menardi* into one another occur. In concluding his valuable remarks on the Upware and Brickhill Brachiopoda, Mr. W. Keeping observes (p. 27), "While thus pointing out the mutability of the forms of Brachiopoda, it is perhaps worth-while observing that the value of the species is thereby in no way decreased, but, on the other hand is, I believe, considerably increased, both to the naturalist and stratigraphist. Whether we call our various forms *varieties, races, types*, or any other name, the facts of the great constancy of our recognised 'specific' types, and their limited distribution in space and time, still remain to us; our characteristic species are as useful as ever they were; while, on the other hand, we shall have added a most important help to the determination of the relations of rock-beds to one another when we can recognise the true meaning of allied genera, species, and varieties." Mr. Keeping gives in his paper a list of the species of Brachiopoda that have been found at Upware and Brickhill; as I possess myself a series of the forms that have been obtained from those localities, I have been able to confirm his identifications.

In his paper (p. 161), Mr. W. Keeping tabulates the Upware and Brickhill Brachiopoda as follows :

	Upware.	Brickhill.
Terebratella Menardi, *Lam.*	×	×
— trifida, *Meyer*	...	×
— oblonga, *Sow.*	...	×
— Fittoni, var. *Meyer*	×	×
— Davidsoni, *Walker*	×	×
— Keepingii, *Walker*	...	×
Kingena rhomboidalis, *Keep.*	...	×
Terebratulina striata, var. elongata, *Dav.*	...	×
Terebratula capillata, *d'Arch.*	×	
— sella, var. Upwarensis, *Dav.*	×	×
— — var. Tornasensis, *d'Arch.*	...	×
— prœlonga, *Sow.*	×	×
— microtrema, *Walker*	×	×
— Lankesteri, *Walker*	×	×
— depressa, *Lam.*	×	×
— — var. uniplicata, *Walker*	×	×
— — var. cyrta, *Walker*	×	×
— — var. Cantabrigensis, *Walker*		

	Upware.	Brickhill
Terebratula Moutoniana, *d'Arch.*	×	×
— — var. Brickhilliensis, *Keeping*	...	×
— extensa, *Meyer*	×	×
— Seeleyi, *Walker*	×	×
— Meyeri, *Walker*	×	×
— Dallasii, *Walker*	×	×
Waldheimia celtica, *Morris*	× ?	×
— pseudo-jurensis, *Ley.*	×	×
— faba, *d'Orb.*		?
— Juddi, *Walker*	×	×
— tamarindus, *Sow.*, var. magna, *Walker*	×	×
— Wanklyni, *Walker*	×	×
— Woodwardi, *Walker*	×	
— Bonneyi, *Keeping*	...	×
Rhynchonella latissima, *Sow.*	×	×
— antidichotoma, *Buv.*	×	×
— Upwarensis, *Dav.*	×	×
— Cantabrigensis, *Dav.*	×	×
— depressa, *Sow.*	×	×

From the Middle Neocomian of Tealby, Lincolnshire, or from the Iron-workings, the following Brachiopoda have been collected by Prof. Judd and Mr. G. H. Fowler:

Terebratula depressa, Dav.
— *sella*, var. *plicata*, Walker.
Waldheimia faba, d'Orb.
— *hippopus*, Roemer.
Waldheimia Walkeri, Dav.
— *tamarindus*, var. *Tilbyensis*, Dav.
Rhynchonella multiformis, Roemer.
— *Walkeri*, Dav.

9. Terebratula moutoniana, *d'Archiac*, var. Brickhillensis, *Keeping*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, fig. 8.

In the table to his work on the 'Fossils of the Neocomian Deposits of Upware and Brickhill' (p. 162), Mr. W. Keeping gives the varietal designation of *Brickhillensis* to a finely radiately striated form of d'Archiac's *T. Moutoniana;* but it has still to be ascertained whether this character is a constant one. It is shown in our fig. 8. We have also, in the same plate, fig. 7, given a figure of a large example of *Terebratula depressa*, Lamarck, from Brickhill.

10. Rhynchonella depressa, *Sow.* Dav., Cret. Mon., Pl. XI, figs. 28—32.

We refer once more to this characteristic fossil in order to allude to the Rev. W. Downes' paper on "Blackdown," published in the 'Transactions of the Devonshire Association for the Advancement of Science, &c.,' 1880. In this paper the author states that lithologically the Blackdown Hills may be said to consist in a descending series of—

1st. An impersistent capping of chalk flints in a clayey matrix—

2nd. Chert beds of varying thickness.

3rd. Greensand, containing highly fossiliferous bands with concretions: the whole very nearly horizontally stratified.

It is remarkable how exceedingly rare is the occurrence of Brachiopoda in the Greensand bands of that celebrated locality. In the 'Cretaceous Supplement' I allude to a specimen of *Rhynchonella depressa*, from Blackdown, in the Woodwardian Museum, Cambridge; since then Mr. Downes has kindly forwarded for my inspection two more examples from the collection of Mr. Walrod, of Dulford House, near Collumpton, and he assures me that, although Brachiopoda had been diligently sought for in the Blackdown Greensand by himself and others, he had never seen more than the two specimens above referred to, and that the Blackdown bands containing them are in all probability referable to the upper part of the Lower Greensand.

JURASSIC SPECIES.

Subsequent to the publication of my 'Oolitic and Liassic Supplements,' the Inferior Oolite in the counties of Dorset and Somerset has again been most diligently searched for Brachiopoda by Mr. S. S. Buckman, F.G.S. He has described the larger number of his new discoveries in vol. iv of the 'Proceedings of the Dorset Natural-History and Antiquarian Club' for 1882. In his Memoir, unfortunately unaccompanied by figures, the author has been able to add materially to the number of species that I had previously described and figured in the 'Proceedings' of the same Club for 1877.

The Inferior Oolite of those Counties has produced a very much larger number of species and variations in form than any other British district hitherto investigated, and for Inferior-Oolite species can be compared with that of Normandy.

The Dorsetshire beds have been likewise thoroughly searched by Prof. Buckman, Mr. D. Stephens, Mr. E. Cleminshaw, Mr. J. F. Walker, the Rev. G. F. Whidborne and some others. The variety of forms that have turned up has been truly surprising.

Mr. S. S. Buckman has also carefully defined the zones from which each species had been obtained, an investigation which constitutes the most important feature of his paper.

I now give descriptions and figures of the new species. Of some few of them the material has been scanty, and the discovery and study of more specimens will be necessary before their specific claims can be considered as definitely established. I also notice a few Portlandian species described by the Rev. Prof. J. F. Blake, so as to complete the British series as far as the present state of our knowledge will permit.

I am convinced that the number of so-called British Liassic and Oolitic species described in my 'Monograph' will require to be materially reduced, as some of them will undoubtedly turn out, with further careful study, to be variations in form or synonyms of some of the others. This should, however, be done only after careful consideration.

1. Terebratula Morierei, *E. Desl.* Dav., Appendix to Supplements, Vol. V, Pl. XVIII, fig. 11, 11 *a—d.*

Terebratula Morierei, *Dav.* Annals and Mag. of Nat. Hist., 2nd ser., vol. ix, April, 1852.
— — *Desl.* Descript. des Brachiopodes du Système Ool. Inf. du Calvados, Bull. Soc. Linn. de Normandie, vol. ii, pl. iv, fig. 6, 1857.
— — — Pal. Franç., Brachiopodes Jurassiques, p. 244, pl. lxv, figs. 1—8, 1874.
— — *Walker.* On the occurrence of *Tereb. Morierei* in England, Geol. Mag., Dec., 1878.
— — *A. U. Kent.* The finding of *Tereb. Morierei* at Bradford-Abbas, Dorset, Prod. of the Dorset Nat.-Hist. Club, vol. iii, p. 39, 1879.
— — *S. S. Buckman.* The Brach. from the Inf. Ool. of Dorset, Proc. of the Dorset Nat.-Hist. Club, vol. iv, p. 48, 1882.

Shell subpentagonal, rather longer than wide. Valves moderately convex, slightly flattened, with a deep longitudinal angular sinus or groove in each valve, extending from the beak and the umbo to the front, so that at the junction of the two sinuses in front a deep angular indentation is produced; beak moderately incurved and truncated by a circular foramen; deltidium small, beak-ridges sharply defined, leaving between them and the hinge-line a well-marked false area. Surface of valves covered with numerous concentric step-like ridges with flattened interspaces, covered with circular pits or perforations, giving the surface a granulated appearance. A large specimen measured 9 lines in length, by the same in breadth, and 5 in depth. The shell is, however, usually smaller.

Obs.—This important and well-marked species was for the first time discovered by M. Morière at St. Honorine-des-Perthes, near Port-en-Bessin, Normandy, in beds named by M. de Caumont, "Calcaire marneux de Port-en-Bessin," and which, according to M. Deslongchamps, correspond with the Inferior Oolite of Normandy, or rather the white bed lying immediately above the ferruginous Oolite of Bayeux. It thus characterises the zone of *Am. Parkinsoni.*

In 1851 the shell was forwarded to me by M. Deslongchamps, for description and illustration, with the MS. name *T. Morierei.* In England the first specimen was discovered in 1878 by Mr. J. F. Walker, in the Inferior Oolite of Bradford-Abbas in Dorsetshire, and subsequently other examples were collected by Mr. D. Stephens, Professor Buckman and his son, Mr. Kent, Rev. G. F. Whidborne, and others, but it is by no means a common species. It is easily distinguishable from *Terebratula coarctata* and *T. reticularis* by the absence of a mesial fold in the dorsal valve, as well as by the absence of radiating striæ, and from *T. hybrida* by the absence of radiating lines.

2. Terebratula hybrida, *E. Desl.* Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 12 and 12 *a*, *b*, *c*.

Terebratula hybrida, *E. Desl.* Catalogue descriptif du Brach. du Système Ool. Inf. du Calvados, Bull. Soc. Linn. de Normandie, vol. ii, pl. iv, fig. 7, 1857.
— — — Pal. Française, Brachiopodes Jurassiques, p. 247, pl. lxvi, figs. 1—6, 1874.
— — *S. S. Buckman.* Proc. of Dorset Nat.-Hist. Club, vol. iv, p. 24, 1882.

Shell subpentagonal, about as wide as long. Dorsal valve very moderately convex, somewhat flattened, with a deep median sinus bordered by a rounded rib; ventral valve much deeper and more convex than the opposite one, with also a deep sinus commencing at the beak and extending to the front; beak slightly incurved and truncated by a large circular foramen, separated from the hinge-line by a small narrow deltidium. Surface of valves covered with numerous radiating raised striæ, crossed at right angles by concentric lines, giving the surface an elegant reticulated or trellis-like appearance.

Length 7, width 7 lines.

Obs.—This species by its shape is closely allied to *Ter. Morierei*, but differs from it in its exterior sculpture, its valves being covered with radiating lines, as well as by concentric ones. It differs also from *Ter. coarctata* by the presence of a mesial sinus in both valves. *Terebratula hybrida* was found by M. E. Deslongchamps in the White Oolite reposing on the Inferior Oolite of Bayeux, at St. Honorine-des-Perthes near Port-

en-Bessin in Normandy, that is to say, in the zone of *Am. Parkinsoni*. In England it was discovered for the first time by Mr. D. Stephens, and subsequently by Mr. S. S. Buckman, in the same zone at Broadwindsor in Dorsetshire, where the shell appears to be very rare.

3. Terebratula Eudesiana, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 18, 18 *a*, *b*.

Shell ovate, as long as, or a little longer than wide, broadest anteriorly, sides rounded, indented in front; dorsal valve convex, at about half its length a narrow concave depression, margined by a rounded elevation or rib, extends to the front; ventral valve rather deeper than the opposite one, with a mesial sinus margined by a rounded rib, which commences at a third of the length of the valve and extends to the front; beak incurved and truncated by a circular foramen. Two specimens measured—

Length 7, breadth 8, depth 7 lines.

Length 6, breadth 6, depth 6 lines.

Obs.—This small species seems to be well distinguished from its congeners, and is abundant in the Inferior Oolite (zone of *Am. Sowerbyi*), at Half-way House (Sherborne) and Bradford Abbas in Dorsetshire, and where it has been collected by Mr. S. S. Buckman and the Rev. G. F. Whidborne, and forwarded to me for description. It has been also found at Corton-Denham, Somerset. It does not appear to have ever much exceeded the dimensions above stated.

4. Terebratula Tawneyi, *Whidborne*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 14, 14 *a*, *b*.

Terebratula Tawneyi, *Whidborne*. Quarterly Journal Geol. Soc., vol. xxxix, p. 536, pl. xix, fig. 12, 1883.

Shell marginally almost circular; dorsal valve deeper and more convex than the opposite one; beak incurved, foramen circular and completed laterally by two small plates as well as by the umbo of the opposite valves. Surface of both valves covered with fine radiating raised lines, with shorter ones between the principal ones.

Length 5, width $4\frac{1}{2}$, depth 3 lines.

Obs.—This small species is remarkable on account of its striated surface, and was found by the Rev. G. F. Whidborne, F.G.S., in the Inferior Oolite at Dundry near Bristol.

5. Terebratula curviconcha, *Oppel.* Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs, 15, 15 *a*, *b*.

Terebratula curviconcha, *Oppel.* Zeitschrift deutschen Geol. Gesellschaft, p. 206, pl. v, fig. 6, 1863.
— — *Benecke.* Ueber Trias und Jura in den Südalpen, p. 176, 1866.
— nuculata, *Dumortier* Sur quelques gissements de l'Oxfordien Inf. de l'Ardèche, p. 43, 1861 (not *T. nucleata*, Schl.).
— — *Quenstedt* (pars). Petrefaktenkunde Deutschlands, Brachiopoden, p. 361, pl. xlvii, fig. 111, 1861.
— curviconcha, *E. Desl.* Pal. Franç., Brachiopodes Jur., p. 319, pl. 91.

Shell transversely oval, or wider than long, sides rounded, indented in front; dorsal valve moderately convex, divided into three lobes, of which the central one is in the shape of a deepish concave sinus; ventral valve deeper and more convex than the opposite one, with a broad, rounded, keel-shaped fold, commencing at the beak and widening as it reaches the front; beak incurved and truncated by a circular foramen. Interior not known.

Length 10, breadth 11, depth 7 lines.

Obs.—Mr. S. S. Buckman found two or three examples of this well-marked species in the Inferior Oolite (zone of *Am. Humphriesianus*), near Half-way House (Sherborne), Dorset. M. Deslongchamps states, in his description, that according to M. Munier-Chalmas it occurs in the Fuller's earth, but that Dr. Oppel quotes it from the Upper Dogger, or upper part of the Inferior Oolite, at Mitterwand near Hallstadt (Bavaria). French specimens are obtainable at La Voulte (Ardèche).

6. Terebratula (?) Boloniensis, *Sauvage et Rigaux.* Dav., Jurassic Sup., p. 154, Pl. XIX, figs. 1 and 2, and Appendix to Supplements, Vol. V, Pl. XVIII, fig. 19.

Waldheimia Boloniensis, *Rigaux.* Blake, Quarterly Journ. Geol. Soc., vol. xxxvi, p. 227, 1880.

Since describing this rare British fossil at p. 154 of my 'Oolite Supplement,' Prof. Judd has collected specimens, exactly similar to those that occur much more plentifully near Boulogne-sur-mer, in the Portland stone at St.-Alban's Head, Dorset. I am not acquainted with its interior.

7. Terebratula Craneæ, *Dav.* Dav., Jurassic Sup., p. 151, Pl. XX, figs. 1 and 2.

Since I described this scarce British species in the 'Dorset Nat.-Hist. and Antiquarian Field Club,' vol. i, pl. ii, fig. 3, 1877, the same fossil has been found and redescribed by Dr. Ladislaus Szajnocha, from the Inferior Oolite of Hungary, by the name of *Terebratula Hungarica*, Suess, MS. ('Ein Beitrag zur Kenntniss der jurassischen Brachiopoden aus den Karpathischen Klippen,' in Sitzb. der k. Akad. der Wissensch. Bd. lxxxiv, 1 Abth. Juni-Heft, 1881.) Dr. Szajnocha was not aware that I had previously described the species in 1877. *Ter. Craneæ* is a well-characterised and distinct species.

8. Terebratula Ferryi, *E. Desl.* Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 20, 20*a*, and 21*a*, *b* (not *T. Ferryi*, Desl., Dav., Jurassic Sup., p. 139, Pl. XVII, figs. 7 and 8, which is the *T. Hollandæ*, S. S. Buckman).

Terebratula Ferryi, *E. Desl.* Note sur l'étage bajocien des environs de Macon, p. 35, Mémoires Soc. Linn. de Normandie, vol. xii, 1860.

— — — Études critiques sur des Brachiopodes nouveaux ou peu connus, 3éme fasicule, p. 26, pl. v, figs. 1—4, Bull. Soc. Linn. de Normandie, vol. vii, 1862.

— — — Pal. Française, Brach. Jurassiques, p. 332, pl. 96.

— — *S. S. Buckman.* Proc. of the Dorset Nat.-Hist. Club, &c., vol. iv, p. 17, 1882.

Shell globulose, usually longer than wide; dorsal valve strongly biplicated, widest anteriorly, biplications commencing at about half the length of the valve, wide apart, with a deep concave sinus, regular or irregular in shape, with one or two short accessory plications, very convex posteriorly or at the umbo, lateral margins rounded, without plications; ventral valve rather deeper and more convex than the dorsal one, slightly compressed, with a wide median lobe or fold commencing at about the middle of the shell and margined on either side by a rounded rib; the fold is either simply rounded or with two or three shorter ribs, as in the sinus of the opposite valve; beak incurved and truncated by a circular foramen, slightly overlying the umbo of the opposite valve. A large example measured—

Length 1¼ inch, breadth 1 inch, depth 11 lines.

Obs.—At p. 139 of my 'Jurassic Supplement' I described as *T. Ferryi* a strongly biplicated *Terebratula*, which Mr. Walker thought might be a form of M. Deslongchamps'

species. Subsequently Mr. S. S. Buckman, in his paper above alluded to, expressed the opinion that the specimens I had referred to Deslongchamps' species differed sufficiently from the French types to constitute a new species. Through the kindness of M. Deslongchamps, Mr. S. S. Buckman and myself have been enabled to examine a typical series of French examples, and found them to agree in every particular with others which Mr. S. S. Buckman had procured from the Inferior Oolite (*Am. Parkinsoni* zone) near Oborne in Dorsetshire, and he therefore proposed to give the name of *Hollandæ* to the nearly allied form I had previously described as *T. Ferryi* in p. 139 of my 'Jurassic Supplement.' According to M. Deslongchamps, *T. Ferryi* occurs in the Fuller's earth in all the east of France, in the Moselle, the Haute Marne, the Yonne, and Soane-et-Loire. The types sent to me by M. Deslongchamps came from the Montides Fouilly, Soane-et-Loire. It seems to vary a good deal in shape and size; some of the French specimens being as wide as long.

9. Terebratula Hollandæ, *S. S. Buckman* (as *T. Ferryi*, Desl. Dav., Jur. Suppl., Pl. XVII, figs. 7, 8). Appendix to Supplements, Vol. V., Pl. XVIII, fig. 22, 22*a*.

Terebratula Hollandæ, *S. S. Buckman*. Proceed. Dorset Nat.-Hist. Club, p. 27, 1882.

This species is described at p. 139 of my 'Jurassic Supplement' under the mistaken name of *T. Ferryi*, E. Desl. In *T. Hollandæ* the shell tapers posteriorly more than in *T. Ferryi*, and the biplications are sharp and angular as in *T. Phillipsii*; there is also a rounded rib on each of the lateral portions of the valve. In the ventral valve the mesial lobe or fold is angular with a deep sulcus on either side.

Length 12, breadth 8, depth 8 lines.

T. Hollandæ occurs in the Inferior Oolite at Bradford-Abbas, Clifton-Maybank, and near Half-way House, near Sherborne, in Dorsetshire. *T. Ferryi* and *T. Hollandæ* seem to be nearly related species.

10. Terebratula Leesii, *S. S. Buckman*. Dav., Appendix to Sup., Vol. V, Pl. XVIII, figs. 16, 16 *a*, *b*.

Waldheimia carinata, var. Mandelslohi, *Dav.* (not of *Oppel*). Proc. Dorset Nat.-Hist. Club, pl. iii, fig. 8, 1877.

— — — — Jurassic Sup., pl. xxiii, fig. 16 only, 1878.

Terebratula Leesii, *S. S. Buckman*. Proceed. Dorset Nat.-Hist. Club, p. 28, 1883.

Shell almost circular, as broad as long. Dorsal valve gently convex and slightly depressed along the middle. Ventral valve moderately convex; beak incurved; foramen circular, surface smooth.

Length 12, breadth 12, depth 5 lines.

Obs.—Mr. S. S. Buckman states in his paper on the "Dorsetshire Brachiopoda," above referred to, that he possesses internal casts of his *T. Leesii*, and that they show no septum in the dorsal valve, and that it is a *Terebratula* and not a *Waldheimia*. It is distinguished from *T. curvifrons* by a shallower sinus, and comes exactly between the last-named species and *T. ampla*; it was figured by myself as *Wald. carinata*, var. *Mandelslohi*. It occurs in the Inferior Oolite at Bradford-Abbas, and Marston Road, Dorset; and Stoford, Somerset.

11. Terebratula Cortonensis, *S. S. Buckman*. Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 3, 3 *a*, *b*.

Terebratula Cortonensis, *S. S. Buckman*. Dorset Nat.-Hist. Club, vol. iv, p. 49, 1882.

Shell longitudinally oval, longer than wide, broadest anteriorly. Dorsal valve slightly convex, somewhat flattened, or gently raised near the front. Ventral valve deeper and much more convex than the opposite one, with a very slight depression close to the frontal margin; sides rounded, beak incurved, projecting forward over and beyond the umbo of the dorsal valve; foramen of moderate size, nearly touching the dorsal umbo. Surface of valves smooth.

Length $1\frac{1}{4}$, breadth 1 inch 7 lines.

Obs.—In his description Mr. S. S. Buckman observes that "this is a peculiar species, occupying, as it were, a position intermediate between the variations of several other species. It approaches *Terebratula punctata*, var. *Haresfieldensis*, but is distinguished from it by greater proportionate breadth, much flatter dorsal valve, recurved side margin, and beak projecting beyond the dorsal valve. It also approaches *T. Buckmani* and the young of *T. perovalis*, but is much shorter, broader, and more circular in shape than the first and lacks the biplications of the second." *T. Cortonensis* was obtained by Mr. Buckman from the Inferior Oolite, in the zone of *Am. Sowerbyi*, near Corton Denham, in Somerset, also at Bradford-Abbas, Dorset. In France it occurs in the Departments of Sarthe, Meuse, and Moselle. Although somewhat different from *T. punctata* and *T. Haresfieldensis*, this form is difficult to characterise, and I feel uncertain as to its specific characters; I give it on Mr. Buckman's authority.

12. Terebratula linguifera, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 1, 1 *a*, *b*.

Shell obscurely subpentagonal, longer than wide, broadest about the middle. Dorsal valve with a produced linguiform, flattened, or biplicated mesial fold, commencing to rise at about two thirds of the length of the shell and extending to the front. Ventral valve rather more convex and deeper than the dorsal one, with a flattened mesial sinus commencing at about two thirds of the length of the valve; beak incurved and truncated by a circular foramen.

Length $1\frac{1}{2}$ inch, breadth $1\frac{1}{4}$ inch, depth 10 lines.

Obs.—I believe this to be the same species as the one referred to a variety of *T. Kleinii* at page 123, and Pl. XVII, fig. 9 of my 'Jurassic Supplement,' but it is questionable whether it is a variety of Lamarck's species. Mr. S. S. Buckman when forwarding the specimen to me for description gave it the name *linguifera* on account of the shape of its mesial fold. It occurs in the Fuller's earth rock at Haydon, Dorset. The first Dorsetshire specimen was discovered by Mr. E. Cleminshaw.

13. Terebratula provincialis, *E. Desl.* (*?*) Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 2, 2 *a*, *b*.

Terebratula provincialis, *E. Desl.* Brach. Jurassiques, Pal. Franç., pl. xxxiv, 1873.

— — *S. S. Buckman.* Proc. of Dorset. Nat.-Hist. Field Club, vol. iv, p. 25, 1872.

Mr. S. S. Buckman thinks he can refer to Deslongchamps' species a specimen he obtained from the Inferior Oolite, *Am. Murchisoni* zone, Hawthorn Down, near Corton Denham, Somersetshire, and believes that this species is to *Ter. curvifrons* what *Wald. Meriani* is to *Wald. carinata*. He adds, in his description, that the very much incurved beak is its distinguishing feature. It is also deeper and narrower in proportion than *T. curvifrons*, but the sinus in the smaller valve is not so deep. It would be very desirable that more specimens should be collected so as to confirm the identification given here on Mr. S. S. Buckman's authority. The Dorset specimen which Mr. S. S. Buckman identifies with *T. provincialis* is certainly very like the figure Deslongchamps gives of the last-named shell in pl. lxxxiv, fig. 4, of his 'Brachiopodes Jurassiques.'

14. Terebratula gravida, *Szajnocha*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 17, 17 *a*, *b*.

Terebratula gravida, *Szajnocha*. Ein Beitrag zur Kenntniss der jurassichen Brachiopoden, Sitz, Akad. der Wissensch., Bd. lxxxiv, pl. ii, fig. 3, 1881.

— — *S. S. Buckman*. The Brach. from the Inf. Ool. of Dorset, Proceed. of the Dorset Nat. Hist. Club. vol. iv, p. 46, 1882.

Shell subpentagonal, longer than wide, broadest anteriorly, tapering posteriorly, sides rounded, nearly straight or very slightly curved in front. Dorsal valve very convex, narrow, and much incurved, inflated at the umbo, flattened along the middle; anteriorly front line slightly raised with sometimes a tendency to biplication. Ventral valve very convex and slightly keeled; beak small, very little produced and truncated by a small circular foramen lying close to the incurved umbo of the opposite valve; lateral portions of the beak slightly concave. Surface smooth, marked only by a few concentric lines of growth.

Length 14, breath 11, depth 10 lines.

Obs.—In his memoir above alluded to, Mr. S. S. Buckman refers the species under description, with some uncertainty, to *T. gravida*, Szajnocha, and adds that the junction of the valves is much straighter in the single figure he gives of his species.

The general appearance of some of the specimens collected by Mr. S. S. Buckman from the Inferior Oolite near Half-way House, in Dorsetshire, bears so close a resemblance to Szajnocha's figure that I believe one may safely refer them to it. The shell has a very peculiar aspect difficult to describe, and which distinguishes it from its congeners. It is also remarkable that associated with it, both in England and in the Carpathian Rocks, we find *Terebratula Craneæ* of which Szajnocha's *Terebratula Hungarica* is a synonym. *Terebratula gravida* seems to vary a good deal in shape, but still preserves its remarkable aspect.

15. Terebratula Sherbornensis, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XIX, fig. 5, 5 *a*, *b*.

Shell subpentagonal, globose, longer than wide, curved laterally, straight or slightly indented in front. Valves very convex or inflated. Dorsal valve with two slightly projecting, rounded elevations or ribs, commencing to rise at about two thirds of the length of the valve and widely separated by a shallow, slightly concave depression.

Ventral valve with a slightly convex mesial fold, limited on either side by a feebly marked groove; beak truncated by a small circular foramen lying close to the umbo of the dorsal valve. Surface smooth, marked only by lines of growth.

Length 14, width 12, depth 12 lines.

Obs.—It seems evident that *Terebratula sphæroidalis*, Sow., *T. Sherbornensis*, Buckman, *T. conglobata*, Desl., *T. Fileyensis*, Walker, *T. Eudesi*, Oppel, *T. globata*, Sow., *T. Eudesiana*, Buckman, and some others, are all closely allied and may be connected by insensible passages in shape, so much so indeed that it is very often difficult to say to which of these so-termed species some of the passage forms should be assigned. *T. Sherbornensis*, Mr. S. S. Buckman himself admits to be a form exactly midway or intermediate between *T. sphæroidalis* and *T. Eudesi*, and it is a question whether we are justified in retaining so many specific names for such closely allied forms. It is true that *T. sphæroidalis* when fully developed is a large, very globose, ball-shaped shell, with usually a straight front line, but in some examples this line is gently curved with a slightly raised rounded elevation or rib bordering a feebly marked mesial depression.

Leaving out of consideration the intermediate forms and comparing, for example, *T. Eudesiana* or *T. globata* with *T. sphæroidalis*, it would be difficult to admit the propriety of merging them into a single species. Perhaps it would be better to retain them as named modifications in shape of, say *T. sphæroidalis*, such as var. *Sherbornensis*, var. *Eudesi*, &c.

Ter. Sherbornensis is a common Inferior-Oolite fossil in the *Am. Murchisoni* and *Am. Sowerbyi* beds. Mr. S. S. Buckman stated, when he forwarded the shell to me for description, that he had found it likewise in the Inferior Oolite of Melborne Wick, Somerset, and at Corton Denham in the same county.

I have added a front view of a typical specimen of *T. Eudesi* (Appendix, Pl. XIX, fig. 6) for comparison with a front view of *Ter. Sherbornensis*, the biplication being deeper and closer in Oppel's than in Buckman's form.

16. Terebratula Fleischeri? *Oppel.* Dav., Jurassic Sup., Pl. XVII, figs. 1, 2, 3, and Appendix to Sup., Vol. V, Pl. XIX, figs. 4, 4 *a*.

Terebratula globata, *Sow.*, var., Dav., Jurassic Sup., p. 135, pl. xvii, fig. 1 (2?) 1876.
— Fleischeri, *Oppel.* Dav., Jurassic Sup., pl. xvii, fig. 2, 1876.
— dorsoplana, *Waagen.?* S. S. Buckman, Proc. Dorset Nat. Hist. Club, p. 14, 1882.

Shell somewhat subpentagonal, broadest about the middle, as wide as long or slightly longer than wide. Dorsal valve moderately convex, when at about two thirds of its length the valves become biplicated by the formation of two rounded ribs with a concave mesial

depression between them. Ventral valve rather deeper or more convex than the dorsal one, with a mesial rounded rib, commencing at about half the length of the valve, and extending to the front with a concave depression or rounded groove on either side; beak incurved and truncated by a circular foramen coming quite close to the umbo of the dorsal valve.

Length 16, breadth 15, depth 10 lines.

Obs.—In my 'Oolitic Monograph' (p. 54, and in Pl. XIII) I described and figured Sowerby's types of *Terebratula globata* that had been lent me for that purpose by J. de C. Sowerby, my fig. 2 being taken from the type figured in tab. 436, fig. 1, of the 'Mineral Conchology.' At that period, as stated at p. 136 of my 'Jurassic Supplement,' I had (I believe wrongly) included in Sowerby's species some allied forms, which have been since then removed. Thus of my fig. 4 Oppel created his *T. Eudesi*, and for fig. 7 he proposed his *T. Fleischeri*. He left, however, my fig. 6 among the forms of *T. globata*, and that specimen is referable to the species under description. At p. 135 of my 'Jurassic Supplement' I included the shell under description and *T. Fleischeri* as varieties of *T. globata*, and of this the *Birdlipensis*, Walker, may be another variation in shape; but I was clearly wrong when I included Sowerby's *T. bullata* among the varieties of *T. globata*, this last being a *Terebratula*, while *bullata* is a *Waldheimia*. Professor E. Deslongchamps, in his 'Brachiopodes Jurassiques,' devotes four whole plates to figures of form-varieties of Sowerby's *T. globata*, and includes among them the shell under description, as I had previously done.

At p. 14 (1882) of his paper on the Brachiopoda from the Inferior Oolite of Dorset and a portion of Somerset, Mr. S. S. Buckman refers the large form under description to the *Terebratula dorsoplana* of Waagen ('Geog. Palaeont. Beiträge,' pl. xxxi, fig. 7, 1867), but this identification seems to be uncertain, Waagen's shell being so very much smaller, and more oval.

The biplicated *Terebratulæ*, as a rule, are most puzzling and difficult to separate into species, and it is quite clear to me that many Cretaceous and Jurassic so-termed species have been, as it were, created out of mere modifications in shape of a very variable species.

It may, however, be desirable to separate the shell under description from *T. globata*, and as the large form under description, and *T. Fleischeri*, and the var. *Birdlipensis*, are in every probability mere modifications in shape, they might all be classed under the name of *T. Fleischeri*, although this last name was applied by Oppel only to the elongated modification of the broader form.

Mr. S. S. Buckman, in his paper above referred to, states that the form under description is intermediate in shape to *T. infraoolitica* and *T. perovalis*. It was obtained by Mr. S. S. Buckman from the Inferior Oolite near Sherborne, Dorset, and is abundant at Birdlip and other places in the neighbourhood of Cheltenham.

17. Terebratula curvifrons, *Oppel.* Dav., Ool. Mon., Pl. IV, figs. 15 and 16; Appendix to Vol. I, Pl. A, fig. 17; Jurassic Sup., Pl. XXIV, fig. 33; Appendix to Sup., Vol. V, Pl. XX, figs. 17, 17 *a*.

This species has been fully described and illustrated in p. 153 of my 'Jurassic Supplement.' Since then a magnificent example, 1 inch and 10 lines in length, by 1 inch and 9 lines in breadth, and 1 inch in depth, has been obtained by Mr. E. Cleminshaw from the *Am. Murchisoni-zone* at Corton, near Sherborne, Somersetshire; and of this I have considered it desirable to add a figure in order to show the dimensions to which the shell sometimes attains.

18. Terebratula maxillata, *Sow.* Dav., Ool. Mon., Pl. IX, figs. 1—9; Appendix to Supplements, Vol. V, Pl. XX, figs. 12, 12 *a*, *b*.

I have fully described this important Jurassic species at p. 50 of my 'Oolitic Mon.,' and at p. 121 of the 'Jurassic Supplement.' I there state that this species occurs plentifully in the Forest marble, Bradford Clay, Great Oolite, and Cornbrash, and that there are specimens in the Museum of the School of Mines which have been obtained from the Inferior Oolite. Since writing the above a finely preserved and characteristic example of the species has been kindly presented to me by the Rev. F. Smithe, of Churchdown, which he obtained from the Inferior Oolite at Rodborough. In England the shell attains its largest size in the Cornbrash. In France M. E. Deslongchamps obtained equally large examples from the Fuller's earth ('Pal. Franç., Brach. Jurassiques,' pl. 104, fig. 1).

19. Terebratula? Appendix to Supplements, Vol. V, Pl. XVIII, figs. 13, 13 *a*, *b*.

Shell globular, equal sided, rather longer than wide; valves very convex, evenly without fold or sinus; beak much incurved. Surface of valves covered with about thirty small angular ribs, crossed at intervals by sharply defined lines of growth. Interior not known. From Middle Lias, Munger Quarry, Radstock.

Length 3½, breadth 3, depth 3 lines.

Obs.—The very regularly equal-sided shape of this small specimen, so completely resembles that of a Brachiopod, that it led me to place it *provisionally* among the *Terebratulæ*. Mr. E. Provis assures me that similar but unequal-sided specimens of the same species, and also from the Middle Lias at Munger Quarry, Radstock, are in the Bath Museum, labelled *Cardita multicostata*, and consequently placed among the Lamellibranchiata. More specimens will, however, have to be examined before the shell under description can be correctly classed.

20. Terebratula, sp. Dav., Appendix to Supplements, Vol. V, Pl. XX, fig. 16, 16 *a*, *b*.

Shell transversely oval, widest posteriorly, rounded anteriorly. Dorsal valve very slightly and evenly convex, much flattened, with or without a very shallow median depression on the anterior half of the valve. Ventral valve moderately convex; beak incurved and truncated by a largish foramen touching the umbo of the dorsal valve, and laterally margined by small deltidial plates; beak ridges sharply defined. Surface smooth, marked by a few concentric lines of growth. Interior not known.

Length 1 inch 9 lines, breadth 1 inch 10 lines, depth 8 lines.

Obs.—Two examples of this species were obtained by Mr. E. Cleminshaw from the Inferior Oolite (*Am. Murchisoni*-zone) at Corton, near Sherborne, in Somersetshire. They are both remarkable on account of the very great flatness or very slight convexity of their dorsal valves. Not a trace of a median depression was observable in the largest specimen, and only a very slight indication could be seen in the smaller example.

Feeling uncertain whether this species may not be referable to some of those already described, I have preferred not to give it a specific name. It bears some resemblance to certain forms of *Terebratula Omalogastyr*, Zeiten.

21. Waldheimia Haasi, *S. S. Buckman*, MS. Dav., Appendix to the Supplements, Vol. V, Pl. XIX, figs. 11, 11 *a*, *b*, *c*, 12, 12 *a*.

Shell sub-pentagonal, longer than wide, broadest posteriorly. Dorsal valve slightly convex laterally; median sinus concave, commencing at the umbo, widening and deepening as it reaches the front, with sometimes a longitudinal rounded elevation along the middle. Ventral valve convex, much deeper than the dorsal one, with a broad flattened mesial fold slightly depressed along the middle, with large wide concave slopes; beak moderately incurved, truncated by a small circular foramen, and separated from the hinge-line by small deltidial plates; beak ridges well defined.

Length 1 inch, breadth 9 lines, depth 5 lines.

Obs.—This is a very remarkable and well characterised species. A dark line, extending from the umbo to a third of the length of the valve, shows that it was possessed of an internal septum, and had a long loop. In external shape it approaches most nearly to the *Terebratella bivalvata* of Deslongchamps. Its discovery is due to Mr. S. S. Buckman, who sent it to me with the MS. name of *W. Haasi*, Dr. Hippolyte Haas and Dr. Camille Petri being the authors of the important work entitled 'Die Brachiopoden der Juraformation von Elsass-Lothringen,' Strassburg, 1882. It occurs in the Inferior Oolite (*Am. Humphriesianus* zone) near Half-way House, Sherborne, Dorsetshire.

22. Waldheimia Brodiei, *S. S. Buckman*, MS. Dav., Appendix to Sup., Vol. V, Pl. XIX, figs. 14, 14 *a*, *b*, 15, 15 *a*, *b*.

Shell somewhat circular or obscurely sub-pentagonal, usually as wide as long, sometimes longer than wide. Dorsal valve gently convex and flattened, divided into three lobes, of which the central one is in the shape of a slightly produced mesial fold. Ventral valve moderately convex, with a mesial sinus extending from the beak to the front; beak small, incurved, and truncated by a small circular foramen. Two specimens measured—

Length 8, breadth 8, depth 4 lines.
„ 11, „ 7, „ 5 „

Obs.—This is a well-marked shell, and easily separable from its congeners; its flattened dorsal valve is remarkable. Nothing is known of its interior, but a dark line, extending from its umbo to about a third of the length of the valve, shows that it was possessed of an internal septum and a long loop.

This species was discovered by Mr. S. S. Buckman in the Inferior Oolite (*Am. Humphriesianus* zone) at Louse Hill, near Sherborne, Dorset, where the shell is said to be abundant. It was named by Mr. S. S. Buckman prior to sending it to me for description after the Rev. P. B. Brodie, to whom science is indebted for so many important researches.

23. Waldheimia disculus, *Waagen*. Dav., Appendix to Supplements, Vol. V, Pl. XIX, fig. 17, 17 *a*.

Macandrevia disculus, *Waagen*. Geog. Paläont. Beiträge, pl. xxxi, figs. 8, 9, 1867.
Waldheimia — — S. S. Buckman, Proceed. of Dorset Field Club, vol. iv, p. 29, 1882.

Mr. S. S. Buckman, in his paper on the "Brachiopoda of Dorset," says, "This species was discovered by myself in the *Am. Sowerbyi*-zone in a quarry near Corton-Denham,

Somersetshire, and I do not know that it has occurred anywhere else in England. The adult specimens are very similar to *Wald. anglica*, Oppel, but the peculiar raised beak at once distinguishes it. The young might perhaps be taken for young forms of *Wald. subbuculenta* (Chap. and Dewalque). Waagen found his specimens in the *Sowerbyi*-zone, and says that he has six specimens from Gingen (Württemberg), and does not know it from anywhere else.

It seems to vary considerably in shape, some examples being nearly circular or longitudinally oval, others tapering anteriorly and broadest posteriorly; generally nearly as wide as long, and measuring 8 lines in length by 7 in breadth. It was also found by the Rev. G. F. Whidborne in the Inferior Oolite at Mosterton.

24. Waldheimia Hughesi, *Walker*. Dav., Appendix to Supplements, Vol. V, Pl. XVIII, figs. 23, 23 *a*, *b*, 24.

This species was briefly described at p. 174 of my 'Jurassic Supplement,' but inadvertently not figured. I now fill up the deficiency.

25. Waldheimia reversa, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XIX, fig. 13; Pl. XX, figs. 13, 13 *a*, *b*.

Shell sub-pentagonal, longer than wide, broadest anteriorly, tapering posteriorly. Dorsal valve moderately convex, with a rounded mesial fold commencing at a short distance from the umbo. Ventral rather deeper than the opposite valve, with a concave mesial sinus of moderate depth; beak incurved, and truncated by a circular foramen.

Length 1 inch, breadth 9 lines.

Obs.—I have seen one specimen only of this fossil, and can say very little with respect to its specific value. Mr. S. S. Buckman considers it new, and I describe it as such on his authority. It appears to me to be closely related to *Wald. Haasi*, and especially to those specimens of the last-named species which present a rounded elevation along the middle of the mesial depression in the dorsal valve. *Wald. reversa* was obtained from the Inferior Oolite at Bradford-Abbas in Dorsetshire.

26. Waldheimia carinata, *Lam.*, var. Crewkerniensis, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 8, 8 *a*.

Waldheimia carinata is to some extent variable in shape, but as a general rule is elongated, oval, and rounded in front, as we have represented it in this Appendix, Pl. XIX, figs. 7, 7 *a*; its dorsal valve is also more or less concave, or the two longitudinal halves of the valve slope down to a median groove. Sometimes, however, the front line seems to be nearly straight, and in some exceptional examples indented, as in fig. 15 of Pl. XXIII of the 'Oolitic and Liassic Supplement,' and in fig. 8, Pl. XIX of this Appendix. To this variety Mr. S. S. Buckman has applied the name *Crewkerniensis* to the form sent to me for description. It occurs in the Inferior Oolite zone of *Ammonites Parkinsoni* at Haselbury, near Crewkerne, and Bradford-Abbas, Dorset, as well as at Broadwinsor, in the same county.

27. Waldheimia bisulcata, *S. S. Buckman*, M.S. Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 9, 9 *a*, *b*, 10, 10 *a*.

Shell elongated, sub-pentagonal, widest posteriorly, rounded at the sides, indented in front. Dorsal valve moderately convex, and longitudinally divided into two lobes by a deepish depression. Ventral valve deeper and more convex than the dorsal one, posterior half slightly longitudinally keeled, anterior half longitudinally depressed or grooved along the middle; beak very little incurved; and truncated by a circular foramen separated from the hinge-line by deltidial plates; hinge-ridges sharply defined, leaving between them and the hinge-line a flattened space. Surface of valve smooth, marked by concentric lines of growth.

Length 13, breadth 9, depth 6 lines.

Obs.—I have seen three or four well-characterised specimens of this species. It is distinguished from *Wald. carinata* by its almost straight beak, foramen, and deltidium, the beak in *Wald. carinata* being much incurved; also by the longitudinal depression or sulcation on the anterior half of the ventral valve. The first specimen was found by Mr. S. S. Buckman in the Inferior Oolite, zone of *Am. Parkinsoni*, at Bradford-Abbas, Dorset, and was forwarded to me for description; a second example was collected in the same locality by the Rev. G. F. Whidborne.

28. Waldheimia cor, *Lamarck* (?). Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 16, 16 *a*.

Terebratula cor, *Lamarck*. Animaux sans vertèbres, vol. vi, p. 249, 1819.
— — *Defrance*. Dic. des Sciences Nat., vol. liii, No. 8, p. 151, 1832.
— Rehmanni, *De Buch*. Die Versteinerungen des Oolithen-Gebirges, tab. xviii, fig. 11, 1839.
— cor, *Dav*. Examination of Lamarck's Species of Terebratula, Annals and Mag. of Nat. Hist., p. 5, pl. xv, fig. 22, 1850.
Zeilleria cor, *Bayle*. Explication de la Cart. Géol. de France, vol. iv, Atlas, pl. ix, fig. 4, 1878.

Shell subpentagonal, nearly as wide as long, broadest about the middle. Valves almost equally convex, most so anteriorly, lateral margins rounded, indented in front. Dorsal valve regularly convex to about half its length, when a median depression commences and extends to the front. Ventral valve convex to about its middle, when a similar depression as seen on the dorsal valve extends to the front; front line almost straight; beak moderately incurved, and truncated by a small circular foramen, margined laterally by deltidial plates; beak ridges sharply defined. Surface smooth, marked by concentric lines of growth; loop long.

Length 12, breadth 13, depth 8 lines.

Obs.—Lamarck, in 1819, describes this species as follows:—"T. testa cordiformi subglobosa, supra sinu valde exarata, striis tenerrimis decussatis." No reference to figure, locality, or age of deposit is given by the author, so that much doubt rested on this species until M. Valenciennes found in the collection of the Jardin des Plantes the type specimen, which he forwarded to me, and of which I gave an exact figure in the 'Annals and Magazine of Nat. Hist.,' 2 ser. vol. xv, 1850, pl. xv, fig. 22. For long I could not divest my mind of the idea that it was only a form of *Wald. numismalis*, but M. E. Deslongchamps is of opinion that the two species, although nearly allied, can be distinguished. He says: "Notwithstanding its extreme variation, *T. cor* is easily distinguishable by its out-spread shape, truncated or bi-lobated front, and strong posterior angularity, by its depressed valves near the beaks, and gibbosity towards the front. Its very small foramen distinguishes it from other Terebratulæ with which it might be confounded, except the *T. numismalis* and *indentata*; but the first is nearly always nearly flat and is never inflated anteriorly, and but little indented." He admits that the shell varies in an astonishing manner, and is sometimes flattened, as in *W. numismalis*, and, indeed, I am not yet satisfied that they are more than variations in shape of a single type. As Mr. Deslongchamps and many others separate the two under distinct names, I have provisionally followed them in this supposition; and, indeed, if we are to draw up descriptions from extreme shapes, a difference

would be determinable, but there seems to me to exist so many passage forms between the two that it is hard to know where to draw the line.

My first attention to British specimens of this so-termed species is due to the Rev. G. F. Whidborne, who sent me several examples under the name of *Wald. cor*, which he had collected from the Middle Lias at West Tyning near Radstock.

For the reception of this shell, together with *W. numismalis*, *W. quadrifida*, *W. cornuta*, *W. Egena*, and similar forms, Mr. Bayle, in vol. iv of the 'Explication de la carte géologique de France,' proposes the generic name of *Zeilleria*, and this has been adopted by M. Douvillié and Professor Zittel, but I am at a loss to perceive any valid grounds for removing it and the other named species from King's excellent genus *Waldheimia*.

29. Waldheimia sub-numismalis, *Dav.* Dav. Ool. Mon., Pl. V, fig. 10; Jurassic Sup., Pl. XXI, figs. 1—7; Appendix to Supplements, Vol. V, Pl. XX, fig. 14 ,14 *a*, *b*.

At p. 162 of my 'Oolitic and Liassic Supplement' I described some of the shapes assumed by this variable species. Since then I have received from the Rev. F. Smithe an extreme variation similar to a specimen of *W. sub-numismalis* figured by M. E. Deslongchamps in pl. xxix, fig. 4, of his 'Brachiopodes Jurassiques.' By extreme shapes we may connect *W. numismalis*, *W. sub-numismalis*, *W. cor*, *W. quadrifida*, *W. Verneuilii*, Desl., and some others, but the prevalent shape and the larger number of specimens of each of these so-named species are distinct and characteristic. Therefore it would not be right, I think, to club them all under one name.

The shell under notice was procured by the Rev. F. Smithe from the *Am. spinatus* zone, Middle Lias, Churchdown, Gloucestershire. The French examples come from the same geological horizon.

30. Waldheimia anglica, *Oppel.* Dav., Jurassic Sup., Pl. XXIII, figs. 23—26; Appendix to Supplements, Vol. V, Pl. XX, figs. 15, 15 *a*, *b*.

Since describing this species (?) at p. 186 of my 'Jurassic Supplement,' Mr. E. Cleminshaw has found a specimen of the shell in the Inferior Oolite at Corton, near Sherborne, Dorset, measuring $9\frac{1}{2}$ lines in length by the same in breadth, and 5 lines in depth, and so much resembling specimens of *W. Lycetti* in size and shape from the Upper Lias of Bloxham near Banbury, that I much fear *Wald. anglica* can hardly be specifically distinguished from my previously described *W. Lycetti*.

31. Rhynchonella palma, *Szajnocha*. Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 21, 21 *a*, *b*.

Rhynchonella palma, *Szajnocha*. Die Brachiopoden-Fauna der Oolithe von Balin bei Krakau, pl. vii, fig. 15, 16, 1879.

— — *S. S. Buckman*. The Brachiopoda from the Inferior Oolite of Dorset and a portion of Somerset, Proceed. Dorset Nat. Hist. Club, vol. iv, p. 47, 1882.

Shell subpentagonal or obscurely trigonal, broadest and rounded posteriorly, tapering anteriorly, as broad or a little wider than long. Valves very gently convex, much depressed or flattened, front very slightly raised into a small rounded wave; fold in dorsal valve scarcely defined, sinus in ventral valve very slightly marked; beak prominent, feebly incurved, with a circular foramen under its angular extremity, surrounded and separated from the hinge-line by deltidial plates. Surface of valves marked by from thirty to forty small, simple, radiating ribs. Two specimens measured—

Length 8, breadth 8, depth 4 lines.

Length 9, breadth 10, depth 4 lines.

Obs.—Mr. S. S. Buckman procured from the Inferior Oolite, *Am. Murchisoni*-zone, at Bradford-Abbas in Dorsetshire, five specimens, which he found to entirely agree with the figures of the specimens published by Szajnocha.

32. Rhynchonella, sp. Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 11, 11 *a*.

Shell trigonal, broadly rounded anteriorly, tapering posteriorly, wider than long. Valves very moderately convex and flattened. Dorsal valve marked with ten angular ribs, of which the four central constitute a very slightly marked fold. Ventral valve slightly depressed anteriorly, presenting a shallow sinus with three angular ribs; beak produced, very gently incurved, with a circular foramen under its angular extremity, reaching to the umbo of the opposite valve, and margined laterally by small deltidial plates.

Length 8, breadth 9½, depth 4 lines.

Obs.—Of this elegant *Rhynchonella* Mr. G. F. Whidborne found a single example in the Inferior Oolite at Bradford-Abbas in Dorsetshire. Although a well-marked form, I have not liked to give it a specific name, as I have seen but one specimen, and the

species of the genus are so variable that, even with a large series before us, it is very often difficult to discover sufficiently distinctive characters between closely allied forms.

33. Rhynchonella bilobata, *S. S. Buckman.* Dav., Appendix to Supplements, Vol. V, Pl. XIX, figs. 18, 18 *a*—*c*, 19, 19 *a*, *b*.

Rhynchonella bilobata, *S. S. Buckman.* The Brach. from the Inf. Ool. of Dorset, Proc. Dorset Nat. Hist. Club, vol. iv, p. 50, 1882.

Shell triangular, wider than long, widest and broadly rounded anteriorly, tapering posteriorly, sides curved. Dorsal valve slightly convex, flattened, and longitudinally divided by a deepish furrow into two rounded lobes, which slope inwardly towards the median groove. At a short distance from the margin the lateral portions of the shell bend abruptly inwards at right angles to meet the margin of the opposite valve. Ventral valve regularly convex, lateral portions, near the edge, bent at right angles so as to meet the margin of the dorsal valve; beak small, gently incurved, and much produced over the smaller valve. Foramen situated under the angular extremity of the beak and laterally margined by small deltidial plates. Surface of the valves smooth to within a short distance from the margin where ten or twelve short ribs occupy the front and lateral margins of the valves. Front margin much thickened.

Length 5, breadth 6, depth 3 lines.

Obs.—We are indebted to Mr. S. S. Buckman for the discovery of this very remarkable and well-characterised species, of which he obtained seven or eight examples from the Inferior Oolite zone of *Am. Sowerbyi*, at Bradford-Abbas in Dorsetshire, and from near Corton Denham in Somersetshire. Some specimens are broader anteriorly, and the marginal ribs are more developed in some examples than in others. No regular ribs are seen in some specimens, only a little notching at the margin. It differs from *Rh. trigona*, Quenstedt, on account of the deep, narrow furrow in the dorsal valve, as well as by the shortness of its ribs.

34. Rhynchonella Dundriensis, *S. S. Buckman.* Appendix to Vol. I, Pl. A, fig. 28. Appendix to Supplements, Vol. V, Pl. XIX, fig. 20, 20 *a*.

Rhynchonella, sp., *Dav.* Ool. Mon., Appendix to vol. i, pl. A, fig. 28, 1855.
— Dundriensis, *S. S. Buckman.* Proceed. Dorset Nat. Hist. Club, vol. iv, p. 43, 1882.

Shell obscurely sub-pentagonal, wider than long. Dorsal valve convex, with a wide, slightly prominent mesial fold, rising at about the middle of the valve and extending to the front. Ventral valve more convex than the opposite one, with a shallow sinus commencing at about half the length of the valve; beak incurved, with a circular foramen under its angular extremity, margined by deltidial plates; beak ridges sharply defined. Surface of valves covered with a large number of fine radiating ribs or striations.

Length 1 inch, breadth $1\frac{1}{4}$ inch, depth 7 lines.

Obs.—In 1854 I received from the Bristol Museum the loan of a very perfect adult example of the shell under description, and figured it in Vol. I, Appendix, Pl. A, fig. 28, without giving it a specific name. It was said to have been obtained from the Inferior Oolite at Dundrey. Since then two or three young specimens of the same species have been found by Prof. Buckman and by Mr. T. C. Maggs in the Inferior Oolite at Bradford-Abbas in Dorsetshire. Mr. S. S. Buckman gave it the specific name of *Dundriensis*. When young the dorsal valve is nearly flat. This seems to be a good species and remarkable on account of the large number of small ribs that cover its surface.

35. Rhynchonella portlandica, *Blake*. Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 6, 6 *a*, *b*, *c*.

Rhynchonella portlandica, *Blake*. Quart. Journ. Geol. Soc., vol. xxxvi, p. 234, pl. x, fig. 8, 1880.

Shell subpentagonal, about as wide as long. Dorsal valve very convex, with a prominent angular mesial fold and wide lateral slopes; folds variable in shape, sometimes bifid or even trifid; on each of the lateral lobes of the valve are three or four shorter ribs. Ventral valve less deep than the dorsal one, with a large mesial angular sinus, in the middle of which are sometimes one or two shorter ribs, and three or four on its lateral lobes; beak incurved with a small circular foramen under its angular extremity. Surface of the valves marked with close concentric lines.

Length 5, breadth 5 lines.

Obs.—Prof. Blake found this small species in the lower part of the Portland Sand at Black Ven, Portland, and less common in corresponding beds at St. Alban's Head. Prof. Blake seems uncertain whether his species is distinct from *Rh. subvariabilis* from the Kimmeridge Clay of Pottern, Wilts, which is the equivalent of the Swindon and Hartwell Clays, and therefore very little removed in time from the deposit whence his *Rh. portlandica* was derived. *Rh. subvariabilis* is a larger shell, and I have seen too few examples of either species to be able to say if they are really the same. Prof. Blake's figures of *Rh. portlandica* approach also much in shape to *Rh. acuta*.

36. Rhynchonella Beneckei, *Haas (?)*. Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 8, 9, 9 *a*, 10, 10 *a*.

Rhynchonella Beneckei, *Haas*. Brach. d. Juraf. v. Alsass-Lothringen, pl. iv, figs. 3, 6—8 (1, 2, 4, 5), 1881.

— — *S. S. Buckman*. Brach. from the Inf. Ool. of Dorset, Proc. Dorset Nat.-Hist. Club, vol. iv, p. 51, 1882.

Mr. S. S. Buckman refers to Haas's species some specimens of a very variable *Rhynchonella* which he obtained from the Inferior Oolite of Bradford-Abbas in Dorset. He says: "Dr. Haas quotes this species from the Middle Lias, or what he calls *Costatusschichten*, which he places just above the *Margaritatusschichten*. From blocks of stone in the Yeovil Sands (zone of *Lytoceras Jurense*), I have obtained several specimens which agree exactly in all respects with the figures (3 and 6—8) given by Dr. Haas of *Rhynch. Beneckei*. Specimens agreeing with 1, 2, 4, and 5, I have, however, not seen, and therefore have put them into brackets in quoting it. Dr. Haas, however, takes as his typical examples of his species figs. 3 and 7, with both of which our specimens agree exactly.

"The specimens from this district possess two, three, and four ribs on the mesial fold, and the height of them varies considerably. In young specimens the ribs are flat in proportion, and increase in height faster than the shell grows in size, but in specimens of the same size the height of the ribs is often variable.

"This species is, as it were, between *Rh. cynocephala*, Rich., and *Rh. subangulata*, Dav., but in general the mesial fold is not so raised as in either of them. Its ribs also do not extend more than half way up from the base of the shell. As far as I have been able to observe, the deltidial plates of *Rh. cynocephala* are far larger in proportion than those of *Rh. Beneckei*. The far greater number of ribs, continued, too, all up to the beak, distinguishes *Rh. subangulata* from this species. Dr. Haas quotes it from Uhrweiler and Nuelhausen in Alsace; Zocourt and Luppy in Lorraine; also Essey and They (Meurthe and Moselle). This species seems properly to belong in this district to the zone of *Am. Jurensis*." I am very uncertain with respect to this identification, and give it on Mr. S. S. Buckman's authority.

37. Rhynchonella Gingensis, *Waagen*. Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 1, 1 *a*.

Rhynchonella Gingensis, *Waagen*. Geognostisch-paläont. Beiträge, pl. 32, fig. 3, 1867.
— — *S. S. Buckman*. Proc. Dorset Nat. Hist. Club, vol. iv, p. 45, 1882.

Shell obscurely subpentagonal, somewhat broader than long, widest about the middle. Dorsal valve gibbous and divided into three lobes, the central one forming a rounded mesial fold. Ventral valve less convex than the opposite one, with a broad, flattened mesial sinus; beak small, incurved with a circular foramen under its angular extremity, and lying close to the umbo of dorsal valve, lateral portions of the beak and umbo bent inwards at acute angles. Surface of each valve ornamented with about twenty angular ribs of which five or six occur on the fold, four or five in the sinus.

Length 16, breadth 17, depth 13 lines.

Obs.—In his notice of this *Rhynchonella* at p. 45 of his paper on the 'Brachiopoda from the Dorset Inferior Oolite,' Mr. S. S. Buckman says that it is "a species which is closely allied to *Rhyn. subtetrahedra*, Dav., but it is much deeper, with a far more convex dorsal valve, and is not nearly so broad." I quite agree with Mr. S. S. Buckman in these remarks; and it is very probably no more than a variation in shape of the species I had named *Rh. subtetrahedra*. The British examples from the Inferior Oolite of Bradford-Abbas in Dorset are larger than the one figured by Dr. Waagen, and it is stated by Buckman that it occurs chiefly in the zone of *Am. Murchisoni* and less seldom in that of *Am. Sowerbyi*. Dr. Waagen quotes it from Gingen (Württemberg), from many places in France, and from Gunsberg and Betzenan (Switzerland).

38. Rhynchonella fallax, *E. Desl.* Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 4, 4 *a*, *b*, and 5.

Rhynchonella fallax, *E. Deslongchamps*. Études critiques sur des Brachiopodes nouveaux ou peu connus, p. 20, pl. iii, figs. 1—5, Caen, 1862.

Shell subpentagonal, wider than long. Dorsal valve moderately convex, somewhat depressed, divided into three lobes, central lobe wider than the lateral ones, forming a broad, flattened, mesial fold, with large lateral slopes, and ornamented by three or four longitudinal angular ribs; three or four ribs are present also on each of the lateral lobes.

Ventral valve not quite as deep as the dorsal one; mesial sinus large and wide, with three or four longitudinal ribs, a similar number being also present on each of its lateral lobes; beak incurved, with a small circular foramen under its angular extremity, margined by narrow deltidial plates. Two specimens measured respectively:

Length 8, breadth 10, depth 6 lines.

Length 12½, breadth 14, depth 6 lines.

Obs.—At p. 225 of my 'Jurassic Supplement' I alluded to this species as having been found by Mr. C. Moore in the Middle Lias at Whatley, but from Mr. Moore having mislaid his specimens it was not possible for me either to describe or illustrate the species. Subsequently the Rev. G. F. Whidborne obtained five examples of the same species from the Middle Lias at Husch Quarry, Radstock. Four of them were of about the dimensions of those figured by M. Deslongchamps, and one very much larger but still presenting the same characters. It seems to differ in the number of its ribs, these vary from twelve to fifteen in the specimens I have been able to examine.

In his description M. E. Deslongchamps says that his fossil approaches much to *Rh. variabilis*, but differs from it especially on account of the depression of its dorsal valve, and by its larger number of ribs.

Rhynchonella fallax was found by M. E. Deslongchamps to be abundant in the Middle Lias at May and at Bretteville-sur-Laize (Calvados).

39. Rhynchonella buteo, *Suess*, MS. (?). Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 7, 7 *a*, *b*.

Rhynchonella Buteo, *L. Szajoncha*. Die Brachiopodenfauna der Oolithe von Balin bei Krakau, Akademie der Wissenschaften, p. 39, pl. vii, figs. 18—20, 1879.

Shell transversely oval. Dorsal valve convex. Surface ornamented with about sixteen ribs, of which some six form a mesial fold of very small elevation. Ventral valve convex, with a similar number of ribs, and of which five occupy a sinus of moderate depth; beak incurved.

Length 7, breadth 9, depth 5 lines.

Obs.—Mr. S. Buckman has referred to this species some specimens of a *Rhynchonella* he had procured from the Inferior Oolite (zone of *Am. Sowerbyi*) at Bradford Abbas in Dorsetshire. The identification must, however, be considered as provisional as I have not been able to compare our English specimens with Szajoncha's types. Szajoncha described the shell, but Suess gave the name.

40. Rhynchonella balinensis, *Suess*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XX, fig. 3.

Rhynchonella balinensis, *L. Szajnocha*. Die Brachiopoden-Fauna der Oolithe von Balin bei Krakau, Akad. der Wissenschaften, p. 83, pl. vii, figs. 1—3, 1879.

A small, very variable species of *Rhynchonella* from the Inferior Oolite (*Am. Sowerbi* zone) of Bradford Abbas, Dorset, and from Corton Denham, Somerset, has been referred by Mr. S. S. Buckman to the shell figured by Szajnocha. It has some ten angular ribs on each valve, of which four would occupy the mesial fold. I have not been able to compare the shells referred to this species with foreign types, so the identification must be considered as provisional. The shell was named by Suess, but described by Szajnocha.

41. Rhynchonella Dorsetiensis, *S. S. Buckman*, MS. Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 2, 2 *a*, *b*, *c*.

Shell transversely oval, wider than long. Dorsal valve very moderately convex, with a broad convex mesial fold, of moderate elevation, commencing to rise at about the middle of the valve; ventral valve deep and very convex, especially posteriorly, with a concave sinus commencing at a little distance from the beak, and widening as it nears the front; beak incurved, with a small, circular foramen under its angular extremity. Surface of the valves covered with numerous small, radiating riblets.

Length 6, breadth 7, depth 4 lines.

Obs.—This shell was obtained by Mr. S. S. Buckman from the Inferior Oolite, *Am. Humphriesianus* zone, at Halfway House, Sherborne, in Dorsetshire and sent to me for description. It is intermediate in shape between *R. Dundriensis* and *Rh. senticosa*, but has no spines and is easily separable from both.

Spiriferina adscendens, *E. Desl.*, and Sp. Tessoni, *Dav.*

I have been recently informed by Mr. H. Keeping that the above-named fossils, described in pages 227 and 228, Pl. XXIX, figs. 20 and 21, of my 'Jurassic Supplement,' are not British, and do not occur in the Middle Lias near Chideock; and that

it has been ascertained that they occur in blocks of stone, in all probability from Normandy, landed near Chideock and from these the fossils had been extracted and placed in the museum of the Bridport Institution, by mistake, as from Chideock. They had been sent to me for inspection by Mr. C. Moore, who firmly believed them local. I all along felt very uncertain about the matter, and am glad to have been able to rectify the mistake.

42. Koninckella (Leptæna ?) liasiana, *Bouchard*, sp. Dav., Ool. Mon., Pl. I, fig. 21; Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 18, 18 *a*, *b*.

This rare British shell is described at p. 18 of my 'Oolite Monograph.' Since then a perfect bivalve example was found by the Rev. G. F. Whidborne in the Middle Lias (*Cymbium* zone) at Chideock. It measured:

Length $2\frac{1}{2}$, breadth 3 lines.

In the 'Compte-Rendu Sommaire des Sciences de la Société Géologique de France,' 16th February, 1880, M. Munier-Chalmas proposes a new genus, *Koninckella*, for this species, with the following brief diagnosis:—"Test concavo-convexe; spire branchiale formée par trois ou quatre tours disposés comme dans le genre *Koninchina* de Suess. Epines cirrhiales très développées. Type: *Leptæna liasiana*, Bouchard." He adds that of the seven species of *Leptæna* stated to occur in the Lias, four only are referable to the *Leptænidæ;* the three others, *L. liasiana*, *L. Bouchardii*, and *L. rostrata*, are provided with spiral appendages, and should become the type of a new family, *Koninckinidæ*. This I had previously proposed in 1853, but M. Munier-Chalmas was not aware of it when he proposed in 1880 his family *Koninckinidæ*. Indeed, I believe that none of the so-termed *Leptænæ* that occur in the Jurassic formation are really referable to Dalman's genus. The genus being limited to the Silurian, Devonian, and Carboniferous formations.

43. Koninckella Bouchardi, *E. Desl.* Dav., 'Ool. Mon.,' Pl. I, fig. 22; Dav., 'Jurassic Supplement,' p. 92.

This shell, described at p. 19 of the Oolitic Monograph, and at p. 92 of the Jurassic Supplement, as a *Leptæna*, is now placed in the genus *Koninckella*, 'Jurassic Supplement,' p. 92.

44. Koninckella rostrata, *E. Desl.* Dav., 'Jurassic Supplement,' Pl. X, fig. 30.

The species described at p. 92 as a *Leptæna*, is now removed to the new genus.

45. Discina Gunnii, *Dav.* Dav., Appendix to Supplements, Vol. V, Pl. XX, fig. 19.

Shell oval unattached valve; conical, longer than wide, rather broader anteriorly, summit situated at rather less than one third of the length of the shell from the posterior margin; anterior margin rounded, posterior margin very slightly indented; test shining, concentrically finely striated, with here and there a stronger line of growth: attached or lower valve not known.

Length 10, breadth and height 4 lines.

Obs.—Very few species of *Discina* have been found in our British Jurassic rocks, *Discina reflexa*, Sow., being the only species I know of that has passed from the Upper Lias into the passage-beds, which constitute the lowest portions of the Inferior Oolite. *Discina reflexa* proper is smaller in size and proportionately more elevated or more conical than the shell under description, which was found by Mr. Gunn, in company with Mr. T. Beesley, in a light-coloured grit in the Inferior Oolite at Hook Norton Railway cutting (Banbury and Cheltenham Railway), at about seven miles south-west of Banbury. Mr. Beesley informs me that at present he can hardly say more than that the zone of the Inferior Oolite where the *Discina* was found is the lowest of the section at that place, where it rests upon what is usually taken for Upper Lias clay, but which contains Lower Inferior Oolite Ammonites (*Am. opalinus* and *Am. Murchisoni*).

I have named the species after Leonard Gunn, Esq., Treasurer of the Banbury Natural-History Society. The specimen forms part of Mr. Beesley's fine local collection.

Mr. E. Walford has obtained in the Upper Lias of the same locality a specimen of *Discina reflexa*, but it is not more than half the size of *D. Gunnii*.

I avail myself of this occasion to mention that the Rev. P. B. Brodie has found in the Middle Lias of Robinswood Hill, Gloucester, a circular *Discina*, 6 lines in length by the same in breadth, and 2 in height, with a sub-marginal apex; the surface of the upper valve being finely concentrically striate.

The same distinguished geologist found also in the Lower Lias (*Lima* beds and shales) of the Vale of Gloucester and Harbury, near Leamington in Warwickshire, a small *Discina*, which looks like *D. Holdeni*, but is smaller, is nearly circular in shape, and measures a little over a line in length and breadth.

A small *Discina*, probably a small example of *Discina Humphresiana*, was found by the Rev. J. F. Blake in the Portland Sand, Portland.

CARBONIFEROUS.

1. Chonetes Laguessiana, *de Koninck.* Dav., Carb. Mon., p. 186, Pl. XLVII, figs. 12—16, 17, and 18; Dav., Carb. Suppl., p. 312, Pl. XXXIV, fig. 18; Dav., Appendix to Supplements, Vol. V, Pl. XX, figs. 20 20, *a*, *b*, 21, 21 *a*.

This well-known species has been described and illustrated in my 'Carboniferous Monograph' and its Supplement, but its intimate shell-structure had not then been investigated.

It has been said by Dr. Carpenter at p. 37 of his chapter on the intimate structure of the Brachiopoda, forming part of the General Introduction to Vol. I of my 'British Fossil Brachiopoda:' "*Chonetes*, of this genus also, I have examined two species, *armata* and *lata*, both of which are perforated;" but Dr. Carpenter does not explain in what way they are perforated, namely, whether the perforations pass through the entire thickness of the valves or are restricted to certain portions of it, as was shown by Mr. John Young to be the case in the genus *Productus* ('Carb. Suppl.' pp. 295—302). I therefore suggested to my valued friend, Mr. J. Young, that he should examine with care the shell-structure of *Chonetes Laguessiana*, which occurs abundantly and in an excellent state of preservation in the Carboniferous Shales at Capelrig Quarry and other places in Lanarkshire. Mr. Young kindly complied with my solicitations, and also at my request published his observations in the 'Geol. Mag.' Decade 2, vol. x, p. 368, August, 1883. Mr. Young found that, as in *Productus*, the shell of *Chonetes* is not perforated through its entire thickness, and I cannot do better than to reproduce here some of his statements.

"When we examine the outer surface of the shell of this *Chonetes*, in well-preserved specimens, we find that the numerous ribs are comparatively smooth, and that in most specimens they are crossed by a few concentric lines of growth, which are generally placed near the outer margin of the valves. The ribs are also perforated to a certain depth and at irregular intervals, by a slanting series of tubular openings, that were probably occupied by the bases of small spines. They are variable in number, on the average from eight to ten in the length of each rib. If the outer surface of such a specimen is slightly etched with weak acid, so as to remove a thin film of the shell, we then see that each rib is ornamented with a single row of very minute and closely-set tubercle-like pores, that descend vertically for a short distance into the substance of the shell, and then disappear as the surface is etched a little deeper [Pl. XX, figs. 21 and 21 *a*]. Whether these minute perforations ever opened at the surface of the shell as pores, it would now

be very difficult to say, as the openings appear to have been too small to admit any foreign mineral matter into the substance of the shell, by which such external openings could be readily recognised from the ordinary calcite of the shell.

"When a specimen is examined with a pocket-lens, and is held so that the light shall pass through the ribs cross-wise in the direction of their length, the perforations are then seen to extend downwards into the substance of the shell through a layer representing about the thickness of the ribs [fig. 21 *a*]. When looked at in a vertical direction under a low power of the microscope, they appear on the surface of the ribs as minute rows of tubercles, slightly raised above the level of the shell. These tubercles are so close to one another that their bases almost touch each other, and in the layer of the shell in which they have been formed it is evident that the shell-structure, during its growth, has been modified to a certain extent, so as to allow of its arrangement around the perforations into the form of minute tubercles.

"This beautiful and interesting structure I have only found after etching some of my finest-preserved specimens. It seems to be destroyed in those specimens where the shell is much crystallised.

"In the larger, slanting, tubular openings found on the ribs [fig. 20 *b*], these, in etched specimens, are seen to be filled with mineral matter, different from the calcite of the shell, and stand out on the surface as small, short spines. They do not pass through the thickness of the shell, but disappear, as the surface of either valve is etched, near the middle layer. At this point a new series of perforations are seen in the shell-structure which do not reach the outer surface but pass inwards in an upward, slanting direction, and open on the interior of the surface of the valves as numerous, raised, blunt tubercles, that give the inner surface quite a roughened appearance.

"This inner series of perforations are large and wide-set, being most numerous around the outer margin of the valves, and are placed in single rows between each of the ribs, whereas the tubular openings or bases of the spines seen on the outer surface of the shell are all planted on the ribs [fig. 21]. There can, I think, be little doubt about these inner perforations being tubular, as in some specimens they are found to be filled with a darker mineral matter than the substance of the shell, and in thin sections the shell-structure is seen to be arranged around the openings in minute waving or concentric lines of growth. This inner layer of shell around the perforations is dense in its structure, and is penetrated with no smaller series of pores than those seen between the ribs. In this it agrees in its inner shell-structure with several of the species of *Productus*, in which also, as I have already shown, the inner series of perforations never did reach the outer shell-surface.

"The row of tubular spines along the cardinal edge of the ventral valve of this species of *Chonetes* reveals some interesting evidence as to their arrangement, which I do not think has been before recorded. These spines pass right through the thickness of the shell, as tubes, and open on the inner surface, the tubes being often filled with foreign

mineral matter, which, being generally darker in colour than the substance of the shell, reveals the path of the tubes through the shell in the clearest manner. It is well known that the series of cardinal spines in *Chonetes* diverge from the beak on either side of the valve, in a slanting manner towards the outer extremity of the shell, but I do not think it is known that the tubes in their inner path through the shell slanted in the opposite direction, so as to point or converge towards the beak [Pl. XX, fig. 20]. This is beautifully shown in some of the etched specimens I have prepared. In these it is seen that the spines nearest the beak slant inwards at the greatest angle, the inward convergence of the tubes decreasing on either side towards the outer edge of the shell. When the tubes, however, reached the cardinal edge of the shell and were prolonged outwards in the form of spines, instead of continuing to converge towards the beak, they became suddenly bent in the opposite direction, so that they afterwards diverged from the beak in a slanting manner." [The existence of tubes traversing the thickness of the area was noticed for the first time by Count Keyserling.[1]]

"In bringing this note to a close, I have only to remark that the points of interest noted in my investigation of the shell-structure of *Chonetes Laguessiana* are four; these are—

"1. The occurrence on the ribs of both valves of a series of wide-set tubular openings, or bases of spines, that do not pass inwards through the thickness of the shell [fig. 21 *e*].

"2. A row of very minute, close-set pores that are placed along the central line of each rib, but which descend only a very short distance into the shell-substance and then disappear [fig. 21 *f*].

"3. A series of wide-set perforations, not visible at the surface, but which start near the middle layer of the shell and are continued in single rows between each rib in an upward, slanting direction through the shell, and appear upon the inner surface of the valves as numerous raised tubercles [fig. 20 *d*].

"4. A row of tubular spines in the cardinal edge of the ventral valve, that open with round orifices on the inner surface of the shell, the tubes at first converging towards the beak, but on arriving at the outer edge being prolonged as spines and bending suddenly in the opposite direction."

I also sent Mr. Young for examination specimens of Mr. Œhlert's three species of *Chonetes; C. plebeia*, *C. tenicostata*, and *C. sarcinulata*, and although he found their shell-structure much altered and obscured, still he could discern in them numerous depressed and slanting tubercles and spines (visible on the inner surface of the valves and which, as in *C. Laguessiana*, did not traverse its entire thickness). He repeated his observations on specimens of *Chonetes armata* from the Devonian Rocks of Ferques. No visible perforations were to be seen on the outer surface of the valves, but after etching the valves with weak acid, he found that the perforations did not begin to show

[1] 'Geogn. Beobacht. auf Einer Reise in das Petschora-Land.,' p. 213, 1846. See also Œhlert, 'Bull. Soc. Géol. France,' 3rd ser., vol. xi, p. 526, 1883.

themselves until he came close to the inner layer of the valves where they appear in the shell-structure as a series of little greyish-white tubes, slanting upwards towards the beak of the shell, as is seen in *Chonetes Laguessiana*.

In his paper "Ueber die Fossilien der Schlesischen Kohlenkalkes" ('Deutschen Geologischen Gesellschaft Jahrg.,' 1854), P. v. Semenow figured a magnified portion of the shell of *Chonetes hemisphærica*, showing large perforations between the ribs and minute punctures on the ribs, similar to all appearance to what was found by Mr. J. Young to be the case with *C. Laguissiana*. These, however, do not traverse the whole thickness of the valve.

Genus—Aulacorhynchus, *Dittmar*, 1871.[1]

= Genus *Isogramma*, Meek, 1873.[2]

2. Aulacorhynchus Davidsoni, *Barrois*. Dav., Carb. Mon., Pl. LV, fig. 13; Dav., Appendix to Supplements, Vol. V, Pl. XX, fig. 22.

Chonetes concentrica, *Dav.* Carb. Mon., p. 278, pl. lv, fig. 13 (not *C. concentrica*, de Koninck).

Aulacorhynchus Davidsoni, *Barrois*. Recherches sur les terrains Anciens des Asturies, et de la Galice, Mémoires Soc. géol. du Nord., vol. iii, p. 326, pl. xvi, fig. 6, 1882.

At p. 278 of my 'Carboniferous Monograph' I described and figured a large semicircular shell that had been obtained from the Carboniferous Limestone at Kenness Wood, Kinross, in Scotland, and referred it with much uncertainty to the *Chonetes concentrica*, de Kon., after having previously consulted my Belgian friend upon the subject. Since then Dr. C. Barrois has given the specific name of *Aulacorhynchus Davidsoni* to the shell I had referred to *Chonetes concentrica*, having found similar examples in great abundance in the Carboniferous Limestone of Villayana, Onis, Villanueva, and Pola de Leña, in the Asturies. It differs from de Koninck's *C. concentrica* by its much larger dimensions as well as by its more numerous and comparatively smaller concentric ridges.

In 1854 Dittmar described three allied species under the generic name of *Aula-*

[1] 'Ueber ein neues Brachiopoder-Geschlecht aus dem Bergkalk;' K. Akad. Wiss. St.-Petersburg, 1871.

[2] 'Geol. Survey of Illinois,' vol. v, p. 568, 1873.

corhynchus, and Dr. Barrois observes that their generic characters agree well with those observable in the *A. Davidsoni;* his *A. Ussensis* being the species that most nearly resembles the shell under description.

Dr. Barrois says, in his valuable work above referred to, that we must also compare *A. Davidsoni* with the *Productus elegans*, M'Coy, as well as with the *Chonetes ? millepunctata* of Meek and Worthen, of which specimens of medium size ornamented with sixty ribs are identical with the Spanish form. He adds that Messrs. Meek and Worthen hesitated, as did their predecessors, to place this shell in the genus *Chonetes*, and, remarking that it differs from true forms of *Chonetes* by its coarsely punctate structure, proposed for it the new generic name of *Isogramma*, being at the time ignorant of Dittmar's prior name—*Aulacorhynchus*. The punctured structure of the American specimens is so coarse that the interior of the valve, seen with the lens, recalls the disposition of the cells of small *Chaetetes*, the perforations, says Barrois, being so unusually close that the intervals separating them are smaller than their diameters.

These large punctures, adds Dr. Barrois, are equally observable on the specimens from the Asturies; that this structure is especially comparable to that of the Rudistes, it being more prismatic cellular than punctate; the prisms are perpendicular to the lamellæ of the shell, and often delicately subdivided. The medium diameter is of one sixth of a millimètre. The shell is rather thick, attaining in the larger number of specimens one millimètre. The thick cellular layer of the shell is covered outwardly by a thin, smooth layer, which shows no traces of perforation. So that in reality the perforations observable on the inner surface of the valves do not traverse the entire thickness of the valve, and in this respect agree with what has been found to be the case in *Chonetes*, *Productus*, and some of the *Strophomenidæ*.

The interior muscular and other markings are described by Dittmar, P. v. Semenow,[1] and C. Barrois; and they differ notably from what we find in *Chonetes*. I have in Pl. XX, fig. 22, reproduced a figure of a ventral valve, after Barrois, showing the muscular impressions.

[1] "Ueber die Fossilien des Schlesischen Kohlenkalkes;" 'Deutsch. Geolog. Gesellschaft,' 1854.

DEVONIAN.

1. Leptæna? irregularis, *Roemer*. Dav., Appendix to Supplements, Vol. V, Pl. XX, fig. 23.

Leptæna irregularis, *C. F. Roemer*. Das Rheinische Uebergangsgebirge, p. 75, pl. iv, fig. 1, 1844.
— — *Schnur*. Beschreibung Eifel. Brachiopoden, p. 224, pl. xli, fig. 3, 1853.

Shell semicircular, broader than long; hinge-line straight, as long as the greatest breadth of the shell; sides rounded, broadly indented in front. Ventral valve moderately convex, with a deep, concave, longitudinal depression, commencing at about half the length of the valve and extending to the front. Area triangular, narrow; fissure small. Dorsal valve slightly concave, flattened posteriorly. Surface of valves covered with very fine radiating lines.

Length 1 inch 4 lines, breadth 2 inches 2 lines.

The shell is sometimes irregular in shape on account of the median depression not being always situated in the middle.

Of this species one incomplete specimen of a ventral valve only was found by Mr. A. Champernowne in the Middle Devonian at Lummaton, near Torquay. It agrees in every respect with the figures published by Schnur in his work on the Eifel Brachiopoda, as well as with specimens of the same sent to me by Prof. Schnur and by Dr. Kayser, which they had obtained at Gerolstein, in Germany.

Together with this species Mr. Champernowne found in the same locality a specimen of *Atrypa aspera*, with spines half an inch in length.

There still remains a good deal to be done with respect to our Devonian species. The Looe locality is one of considerable interest, and its fossils should be carefully collected. These beds, according to Dr. Kayser, are the equivalent of the Taunus Quartzites of the Rhine, the lowest Devonian deposits of that district. In them Dr. Kayser found the large *Rhynchonella Pengelliana* and several more of our Looe species, and in a similar condition of internal casts and impressions. These Rhenish fossils have been described and figured by Dr. E. Kayser in his 'Neue Beiträge zur Kenntniss der Fauna der rheinischen Taunus quartziten,' 1883.

GENERAL SUMMARY AND CONCLUSIONS.[1]

Before closing this Monograph it has been considered desirable to recapitulate some of the principal results brought to light with respect to the Brachiopoda since 1606.

Thirty years have elapsed since the publication of the General Introduction to the first volume of this Monograph, and during that lapse of years a wonderful amount of precise knowledge has been acquired in all that relates to the history and characters of the class.

The vast importance attached to the study of these low Invertebrates has been fully recognised, and the investigation has become very popular among anatomists, zoologists, palæontologists, geologists, and collectors of fossils. The sea-bottom has been carefully explored in many latitudes, and the fossiliferous rocks have been more or less searched for their fossil representatives. Large and valuable collections of recent and fossil forms have been accumulated and carefully studied, and especially so during the last half century, so that the material and observations in our possession are now very considerable.

Although I have devoted much time to the study of the literature of the subject, I have failed to discover any work in which a Brachiopod had been noticed prior to 1606, when Prince Fabio Colonna quaintly described and figured his *Concha diphya* and two or three more species.[2]

In his important work 'Über Terebrateln," published in 1834, Baron von Buch

[1] In 1847 I briefly alluded to this subject in a paper "What is a Brachiopod?" published in vol. iv of the 'Geological Magazine,' and from which I now reproduce many details. I have also in this Summary, when possible, given the author's own words in connection with some of the points referred to.

[2] In 1847, while making researches in the library of the British Museum for early works treating of the Brachiopoda, I found one by Prince Fabio Colonna, entitled 'Aquatilium et terrestrium aliquot animalium," published at Rome in 1606. In 1616, the author issued a kind of second edition of his 1606 publication, but somehow or other all those writers who have alluded to Colonna's works seem not to have been acquainted with the 1606 or first edition, wherein the *Concha diphya* is for the first time described and figured. At my request Dr. C. F. Parona kindly searched for the first edition in different Italian public libraries; and in the Victor-Emanuel Library at Rome he found a copy of the 1606 book. The 1606 and 1616 books are identical, except that in the first edition, published in 1606, the author does not give his treatise 'De Purpura,' and does not reproduce in the 1616 edition the preface given in 1606. In 1616 F. Colonna published in his 'De Purpurâ' three more species of Brachiopoda. In 1675 Johann-Daniel Major issued at Rome (and at Kiel) another edition of the 'Opusculum de Purpura,' in small quarto.

quotes, with much eulogium, the 1616 edition of Colonna's work only and says that he was the first naturalist who gave his attention to the *Terebratulæ;* also that the work produced a deep impression among naturalists, and that what had appeared remarkable to him did so likewise to others. Hence it is that until later than the half of last century there did not appear a single work on conchology that did not allude to the *Concha anomia* of Colonna. Martin Lister, of Oxford, who was possessed of an acute and just appreciation, and who endeavoured to extricate shells from the confusion into which they were involved, and who undertook to class them into families, of which several are still maintained, did not forget in 1685 to allude to the labours of Colonna.[1]

In vol. ii, p. 29, of his work on 'British Conchology,' Dr. Gwyn Jeffreys says, while treating of *Anomia*, "F. Colonna, the originator of this name, applied it to species of *Terebratula*. About a century and a half afterwards Linné used it in the same sense, for he described the animal as having two arms, and the shell as furnished with two bony processess or radii, the deeper valve being often perforated at the base. But he included in the genus many species which we now recognise as belonging to *Anomia*, thus restricted and long custom has sanctioned the modern use of the word." In the opinion of Forbes, Steenstrup, and Morse the plug of *Anomia* represents simply a modified bissus.

Anomia forms part of the *Lamellibranchiata*, whilst the *Brachiopoda* constitute an independent class or order among the Invertebrates. But where it should be placed in the series is still an undetermined or open question.

The name Brachiopoda (*βραχίων*, an arm; *πούς ποδος*, a foot) was proposed for the class by Cuvier in 1805, and used by Dumeril in 1809, and has since been very extensively adopted. In 1824 Blainville proposed as a substitute for Cuvier's name that of "Palliobranchiata" (*pallium*, a mantle; *branchiæ*, gills), on account of the respiratory system being in his opinion combined with the mantle on which the vascular ramifications are distributed. This term has also been adopted by Prof. W. King, who objected to the name given by Cuvier, on the ground that it is a misnomer. The two variously curved and cirrated brachial or labial appendages, improperly designated as arms or feet, certainly do not appear to subserve the function of locomotive organs; and, on the other hand, the cirri or cilia of these oval appendages (and not the mantle) are regarded by some as the real branchial apparatus, as in Polyzoa.

[1] 'Historia sive synopsis methodica Conchyliorum et Tubulorum.' This is a thick folio volume, and its parts appeared at different periods. In the part for 1685 *Rhynchonella psittacea* is the only Brachiopod described, and it is in the part for 1688 that the great bulk of his Brachiopoda are illustrated. Lister's figures are not very good, but most of them recognisable. The same author issued a small quarto volume in 1678; and in 1823 Dillon published an index to Lister's folio work. See a very interesting paper by E. Morse "On the Relations of Anomia," 'American Naturalist, vol. v, pp. 533—535, 1871.

The Shell.

All Brachiopoda are inhabitants of the sea, and vary extremely in shape and character. The animal, or its soft parts, in every Brachiopod is protected by a shell composed of two distinct valves, and these valves are essentially symmetrical or equal-sided, except in cases of malformation. They are not, however, equal-valved, one of the valves being usually deeper than the other. The larger number of *Clistenterata* (*Terebratula*, &c.) have their valves articulated by the means of two curved teeth developed from the margin of the ventral valve, which fit into corresponding sockets in the dorsal one, or are unarticulated as in the *Tretenterata* (*Lingula*, *Crania*, &c.), the valves being maintained in position by muscular action. The outer surface of some species is smooth, in others variously ribbed, sculptured, and ornamented in different ways, and in many cases coloured with various shades of red, yellow, and bluish-black, and stripes or spots of red and white. Traces of the original colour have been sometimes noticed among the fossil species, as will be found recorded in the pages of this Monograph. As collecting has progressed since 1606 up to 1884, an enormous number of so-termed species have been assembled and carefully studied; and so great is the modification in shape in the same species and in the larger number of forms that one is continually at a loss to draw even a conventional line between two closely-allied so-called species. When one deals with large numbers of specimens the difficulty seems to increase. The shell in some species is extremely thin, semi-transparent, and glassy, and especially so in very deep-sea or abyssal forms, such as in *Terebratulina Dallii*, Dav., *Terebratula Wyvillii*, Dav., *Waldheimia tenera*, Jeffreys, *Discina atlantica*, King, &c. In others the shell is thick and sometimes massive. No Brachiopod discovered that has come under my notice has exceeded a foot in breadth by something less in length (*Productus giganteus*), and while the space left between the valves for the soft parts of the animal is, in a large proportion of the species, great, in others it is so small that one is at a loss to understand where the animal could have been located.

As remarked by Dr. Van Bemmelen, the growth of the shell, in thickness as well as in extent, is exclusively the effect of apposition. The inequality in the thickness of the valves in some forms is very remarkable. As already observed in my Carboniferous Monograph the ventral valve of some specimens of *Productus Llangollensis* attained nearly one inch in thickness, while the thickness of the dorsal valve did not exceed a couple of lines. In *Thecidea leptœnoidea* and *Th. Mayalis*, Desl., the ventral valve is very large, whilst the dorsal valve is not much more than half the size of the ventral one, which it only partially covers.

Name of the valves.—The valves have unfortunately, like the muscles and other parts of the animal, been described by different names, but that of *dorsal* for the smaller or socket valve, and that of *ventral* for the larger or dental valve, are now in general use,

and no good would be attained by altering them. At page 851 of his admirable memoir on the organisation of the Brachiopoda, Hancock says :—"The valves of the Brachiopoda are undoubtedly related anatomically, as stated in the text, although, perhaps, they aught both to be considered dorsal as well as those of the Lamellibranchs, as has been pointed out by Prof. Huxley. If this view be correct, the only difference in the arrangement of the valves of the two classes will be that, while in the latter they are united *along* the dorsal ridge, they are articulated *across* the back of the Brachiopod." The valves have also been sometimes distinguished by the names of *dental* and *socket* valves, but this would not hold good in those species that are unprovided with teeth and sockets. Dr. Jeffreys terms them "upper" and "lower," and in the fourth page of the second volume of his excellent work on "British Conchology" he says: "When the Terebratula is attached by its peduncle the perforated valve is the uppermost, the back of the *Terebratula* is really that part which lies between the arms and mouth, and is close to the apex or point of attachment. Instead, therefore, of calling the valves "*ventral*" and "*dorsal*" it would seem more correct to describe them as "*upper*" and "*lower*," the larger and deeper valve being perforate and uppermost, and the smaller and shallower valve being imperforate and the lowermost." Prof. King makes use of the names "*large valve*" and "*small valve*" in his descriptions.

Prof. H. W. Caldwell, in his preliminary note on the structures and affinities of Phoronis and the Brachiopoda,[1] says that both valves are *ventral;* and in a letter to me he adds, "The valves of the Brachiopoda, after my views, lie in the regions of the body surface corresponding to the *anterior* and *posterior* ventral of other forms. Thus the larger valve of Testicardines is *anterior*, the small, flatter 'dorsal' valve *posterior*. In Ecardines the smaller valve is homologous with the *anterior*, the larger with the *posterior*. In describing them I do not propose to use other terms than these, viz. *anterior* and *posterior* shells."

The ventral valve is usually the larger, and in many genera, as in the *Terebratulidæ*, has a more or less prominent beak, with a circular foramen at or near to its extremity, partly or entirely margined by one or two plates constituting the "deltidium." In other forms there exists a triangular fissure, which either remains open or is partly or entirely arched over by a pseudo-deltidium. In some forms, such as in *Cyrtia exporrecta*, *Strophomena rhomboidalis*, and others, a circular foramen exists in the young age at the extremity of the beak or in some part of the arched deltidium and continues open for some time, when it becomes closed or cicatrised in the adult. Through the foramen passes a bundle of muscular fibres by which the animal is attached to marine objects. Some adhered to submarine objects by a larger or smaller portion of the surface or substance of their ventral valves, as in *Crania parisiensis*, *Davidsonia Verneuili*, &c., or by long spines which were wound round bodies of attachment as in *Productus complecteus* and other species. Lastly, many forms seem never to have been attached at all.

[1] 'Proceedings of the Royal Society,' vol. xxxiv, Nos. 222, pp. 371—382, 1882.

The Shell Structure.

Microscopical investigations in connection with the intimate structure of the shell of the Brachiopoda have led to very important results. The subject is a large one, and has been admirably worked out by several able and accurate observers. The structure of the shell is complicated, and different in some genera and species. It is fibrous without any perforations in *Rhynchonella*. In others it is vertically traversed throughout by canals varying in size, &c., while in some the perforations do not traverse the shell from surface to surface, but are restricted to a portion of its thickness only. It is therefore not sufficient to say that the shell is perforated; one must describe in what manner and to what extent the perforations extend. The numerous careful observations already effected during the last forty years have thrown very considerable light upon the subject, and there remains a good deal more to be done before the investigation can be said to have been exhausted.

In June, 1812, Mr. James Sowerby, in the first volume of the 'Mineral Conchology of Great Britain,' while describing his *Terebratula punctata*, says: "The very minute punctures are arranged in undulating lines. These, although to be found in most of the smoother species under the usual coat, are most conspicuous on the surface in this."

In 1836, in his new edition of Lamarck's 'Histoire naturelle des Animaux sans Vertèbres,' Deshayes says: "Les coquilles des Terebratules ont une structure particulière. Lorsqu'on les examine à un grossissement assez considerable, on leur trouve un test qui semble poreux, qui est finement pointillié, et dont les pointillures ont une forme et une disposition particulière dans chacune des éspèces; il serait curieux et interessant de donner à l'appui des determinations d'éspèces la representation grossie d'une partie du test, et nous sommes convainçu que ce moyen employé avec patience et perséverence, contribuerait puissamment à établir des distinctions précises entre les éspèces dont les formes extérieures sont tellement rapprochées que la plupart des auteurs les confondent sous un petit nombre de denominations communes."

In 1848 Alcide d'Orbigny, after the reading of a paper of mine relating to a claim made by Deshayes[1] to having been the first discoverer of the punctures in the shell of *Terebratula*, says: "Quant à la ponctuation du test, elle est en rapport avec la forme des bras; les éspèces qui ont les bras libres ont le test fibreux; le test est ponctué dans celles qui ont les bras coudes; l'ouverture du crochet est elle même en rapport avec la forme des bras et de la ponctuation."

Since 1843 this important inquiry has been most actively and ably pursued by Dr. W. B. Carpenter and other investigators. In 1852, being fully impressed with the importance of Dr. Carpenter's most valuable discoveries,[2] I asked my distinguished friend to

[1] 'Bull. Soc. Géol. de France,' 22nd May, 1848.

[2] "General Results of Microscopic Inquiries into the Minute Structure of the Skeletons of Mollusca,

add a chapter to my General Introduction, "On the Intimate Structure of the Shell of the Brachiopoda," with illustrations. To this proposal he at once acquiesced and devoted much time and labour to the investigation, and I must refer the student to that memoir and to its plates for more ample details than I can at present impart. The structure of the shell has been shown by Dr. Carpenter, Professor King,[1] Dr. Gratiolet,[2] E. Deslongchamps,[3] Van Bemmelen,[4] Mr. John Young,[5] myself, and others,[6] to be generally distinct from that of the Lamellibranchiata and Gasteropoda. Dr. Carpenter stated, in my first volume, that in the shell of the Brachiopoda there is not that distinction between *outer* and *inner* layers, either in structure or mode of growth, which prevails among the ordinary Bivalves, and that it seems obvious, both from the nature and form of the shell-substance, and the mode in which it is extended, that the whole thickness of the Brachiopod shell corresponds with the outer layer only of the Lamellibranch. He added that he has, however, occasionally met with a second layer in recent *Terebratulæ* within the earlier formed portion of the shell, but confined only to a part, instead of extending beyond it. Also that in the genera of species which have their shell perforated by canals, these canals differ in size, and are situated at variable distances from each other.[7] They make their appearance in the

Crustacea, and Echinodermata," 'Annals and Mag. of Nat. Hist.,' vol. xii, p. 377, 1843. On account of his valuable researches the Royal Society awarded to Dr. Carpenter one of its Royal Medals.

"On the Microscopic Structure of Shells," 'Report of the Fourteenth Meeting of the British Association for the Advancement of Science,' for year 1844, p. 1, and in 'Report Brit. Assoc.' for 1847, p. 93.

Article "Shell," 'Cyclopædia of Anatomy and Physiology,' 1850.

"Intimate Structure of Shells of Brachiopoda" (Davidson's 'Introduction to British Fossil Brachiopoda,' 1853).

"On a Peculiar Arrangement of the Sanguiferous System in Terebratula," 'Proc. Royal Soc. London,' vol. vii, p. 32, 1854.

"On the Shell Structure of *Spirifer cuspidatus*," 'Geol. Mag.,' 1867.

[1] "On some Perforated Palæozoic Spiriferidæ," 'Geol. Mag.,' vol. iv, p. 253, 1867.

[2] "Recherches pour servir à l'Histoire des Brachiopodes," 'Journal de Conchyliologie,' t. viii, p. 49, 2nd ser., 1860.

"On the Histology of the Test of the Class Palliobranchiata," 'Trans. Royal Irish Acad.,' vol. xxiv, p. 439, 1871. Prof. King's important observations have thrown much light upon the intimate structure of the shell, and should be studied.

[3] At p. 17, pl. viii of his 'Paléontologie Française, Brachiopodes Jurassiques,' t. vi, 1862, Mr. E. Deslongchamps describes and figures the shell-structure of the Brachiopoda.

[4] "Over den bouw der Schelpen van Brachiopoden en Chitonen, 1882; and Untersuchungen über den anatomischen und histologischen Bau der Brachiopoda Testicardinia, 1883," in the 'Jenaische Zeitschrift für Naturwissenschaft,' Band xvi, 1883, and 'Annals and Mag. of Nat. Hist.' for May, p. 379, 1883.

[5] Davidson's 'Carb. Supp.,' vol. iv, p. 296. The shell-structure of *Rhynchopora, Orthis, Productus, Chonetes*, &c., has been kindly and ably worked out by Mr. John Young for the pages of my Monograph.

[6] See Bowerbank's "Observations on the Structure of the Shells of the Molluscous and Conchiferous Animals," 'Transactions of the Microscopical Society,' i, p. 123, 1844.

[7] Both Morse and Kowalevsky describe the formation of the shell. Kowalevsky referring to the larva of *Cistella cistellula* prior to the formation of the shell, says, "The shell then consists of a chitinous layer and calcareous prisms, which cease to be deposited at a certain distance from the margin. It is

earliest stages of the development of the shell. The largest measure $\frac{1}{300}$, the smallest $\frac{1}{3000}$ of an inch in diameter. These canals are charged with cellular projections of the fleshy mantle, corresponding in position to the tiny cells spread over the upper surface of the delicate membranaceous covering of the animal.

In some families, however, according to Professor King, the shell-substance consists of three divisions. The innermost and middle divisions, which constitute the entire thickness of the valve, are calcareous, with a prismatic or fibrous structure, while the outer division consists of a very thin membrane. The innermost and intermediate divisions are in some families traversed by minute tubular canals which pass from one surface to the other, for the most part in a vertical direction, and at tolerably regular intervals, but just before terminating, near the outer surface of the epidermis, their orifices suddenly become dilated, the lower half of the canals being considerably smaller in diameter than the upper half. The canals are occupied by cæcal processes proceeding from the mantle, or the fleshy covering of the animal. Their functional nature is, according to Carpenter, branchial or subservient to respiration; but, as observed by Professor King, the outer epidermis, which covers the expanded terminations, would seemingly prevent any communication between the surrounding sea-water and the mantle, so that it may be questioned whether they are at all connected with the respiratory function.[1] In certain genera, as *Rhynchonella*, there are

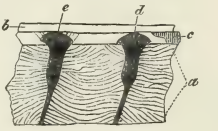
in this part, the youngest of the shell, that the formation of the tubular canals commences. Not a trace of them are to be seen on the posterior portion."

[1] In his valuable memoir on the 'Histology of the Test of the Class Palliobranchiata,' Prof. W. King said that "the innermost division, that is, the one forming the inner surface of the valves, and nearly their entire substance, is calcareous, and has a prismatic or coarsely fibrous structure, as was first made known by M. A. d'Archiac and M. A. d'Orbigny in 1847 ('Mém. Soc. Géol. de France,' 2nd ser., vol. ii, part ii, and 'Annales des Sciences Nat., Zoologie,' 3rd series, vol. viii, pp. 255—257). Its component prisms, which are polygonal and often compressed, lie parallel to one another, and more or less so to both surfaces of the valves, sometimes appearing to form laminæ; but before terminating, which is usually at both bounding planes of this division, they take an outward curve, and their terminations crop out on the inside of the shell, either perpendicularly or obliquely to it; in the former case the terminations give this surface a reticulated aspect, and in the latter they overlap one another, thereby giving it, as Dr. Carpenter correctly expresses, 'an imbricated appearance.' When a portion of a Terebratula shell in a fresh condition is very carefully decalcified (an operation in which my colleague, Dr. Rowney, has succeeded remarkably well with a fragment of *Megerlea truncata*) the entire thickness of the present division is found to be traversed by innumerable delicate 'films' of animal matter, evidently the 'basement membrane' detected by Dr. Bowerbank in the shells of other molluscs. These films, hitherto only seen in the Ancylobranchs by the late Prof. Quekett (see 'Histological Catalogue,' 1850), at least, as far as I can ascertain, appear to both Dr. Rowney and myself to be made up of confluent membranous sheaths, which enclose the shell-prisms; and we are of opinion that the termination of the sheaths, which likewise crop out on the plane corresponding to the inner surface of the valves in the manner of the prisms, form a sort of reticulated or imbricated lining to the said surface. In fossil shells that have lost their basement membrane the individuality of the prisms is more or less obvious; specimens of a Jurassic *Rhynchonella* before me have the prisms so slightly coherent as to be separated easily with a camel-hair pencil. The outer division (*b*, woodcut, p. 293), which was first discovered by Dr. Carpenter, consists of a very thin membrane, corresponding to the epidermis or periostracum of other molluscous classes. The inter-

no canals, the shell being found to consist of flattened prisms of considerable length which lie parallel to one another with great regularity, and at a very acute angle to the surface of the valves. This is the case in all the specimens of Fischer's genus *Rhynchonella;* but in another closely allied genus, *Rhynchopora* (King), and notably in the *Rhynchopora Geinitziana* from the Permian of Gera in Thuringia, Professor King discovered that some

mediate division (*c* of woodcut) is a thin calcareous lamina, just appreciable as such in *Waldheimia australis* and other recent species, lying between the epidermis and the prismatic shell-layer, and distinguished from the last by having a much finer divisional structure; it being for the most part fibrous and compact in the inner portion, and apparently granulo-fibrous and somewhat loose in texture in the outer portion, that is, immediately subjacent to the epidermis. I detected it first in *Productus horridus* under the form of a 'thin superficial lamina' overlying the prismatic division (*a* of woodcut), and it has occurred to me in several other fossils, particularly *Stringocephalus Burtini*. In some cases it may be a calcified form of the epidermis. The three divisions are so intimately united as to be with difficulty obtained in a separate state. The epidermis of *Megerlea truncata* may in some cases be peeled off from the subjacent layer, while the latter occasionally occurs dissevered from the prismatic division in broken specimens of the valve of this and other species.

Shell-structure.



a. Prismatic shell-layer. *b*. Outer division. *c*. Intermediate division. *d*. Projecting rim of perforation. *e*. Radiating closely-packed hairs.

"The canal-system, so characteristic of many palliobranchiate shells, first became a generally received fact through the researches of Dr. Carpenter, published in 1843 and subsequently; it was to some extent previously known, however, to a few palæontologists, notably Prof. Morris, in 1841 (see 'Mineral Conchology,' No. 108, p. 12, March, 1841). It consists of perforations or tubes, which are generally described as passing through the valves 'from one surface to the other;' but, strictly speaking, this is not correct, for their upper portion terminates against or near the under surface of the epidermis. Just before reaching this part the perforations assume a feature not seen elsewhere throughout their length or lower down; thus on entering the intermediate layer they suddenly become dilated, and their aperture or mouth, which is more or less contracted, according to species, by an inwardly projecting rim, abuts against the under surface of the epidermis (*d* of woodcut). The lower half of the perforationsis often considerably smaller in diameter than the upper one. The apertural rims, in specimens which retain the epidermis, appear under a common lens like minute oval or circular spots, often quincuncially disposed over the surface of the valves. When examined with a moderate magnifying power the apertural rims are each seen to be densely crowded with short, excessively fine lines radiately intersecting them, or, in other words, the spots resemble brush-like bundles composed of short, closely-packed hairs radiating from a vacant centre (*e* of woodcut), often of considerable width, as in *Megerlea truncata*, but much smaller in *Terebratulina caput-serpentis* and some other species, &c.

"*Crania anomala* agrees with the Ancylobranchs in having both valves perpendicularly perforated; but this character is not, as in them, distinctly manifested on the outer surface of the shell. In the upper valve the perforations, somewhat slender, are widest at their base, that is, where they open out on its inner surface; in other words, their apertures, when observed with a high magnifying power, are seen to be funnel-shaped, and separated from one another by a tolerably well-defined ridge-like space; but, with a lower power, they simply appear to be separated by a space approximately equal to their own diameter. The apertures occur on the whole of the inner surface of this valve, and they also occur on the corresponding surface of the lower one. Leaving the contracted portion of their funnel-shaped base the perforations pass upwards, with a slight attenuation, towards the opposite surface of the valve; but generally, on reaching the brown layer, they become divided, each one splitting into three, four, or more widely diverging branches," &c.

portions of the valves displayed perforations, whereas others from the Province of Archangel, in Russia, had some parts of the valves quite imperforate; and he explains these differences to be due to the shell-tissue in the latter specimens having become silicified or otherwise modified. This occurs very often, and I have noticed it repeatedly to be the case in a number of Palæozoic specimens, the real structure of the shell having been altered through fossilisation. The punctures in *Rhynchopora Youngii* (Dav.), says Mr. Young, can be seen with the hand-lens, and still better under the microscope.

The punctures vary much in different genera and species, and this circumstance has been often alluded to in the pages of this Monograph. The shell-punctures in *Orthis Michelini* are very remarkable and have been described and illustrated at p. 293 of my 'Carboniferous Supplement.' There we have, according to Mr. John Young's investigations, first, a series of very numerous and minute microscopic perforations or canals that reach the inner surface of the shell, and traverse the whole thickness of the valve; then a second series of pores, larger and less numerous than those of the first series; lastly, a third series, which is at least twenty times larger and stronger than those of the second series, and which belong to the basis of the larger broken spines. Mr. Young ascertained likewise that the pores of the second and third series, referable to the spines, only enter in a slanting direction for a little distance into the substance of the shell.

At my request Mr. Young made a minute examination of the shell-structure of *Productus* and *Chonetes;* and this has been fully given at pages 295 to 302 of my 'Carboniferous Monograph' (vol. iv), and in the 'Appendix to the Supplement,' page 280, *antea* (vol. v). Mr. Young ascertains that the perforations do not in these genera nor in *Streptorhynchus*, *Strophomena*, and *Leptæna*, pass through the entire substance of the shell, but that in *Productus* they enter from the inner surface of the valves and gradually get smaller and smaller as they pass outward through part of the substance of the shell, and are lost *before* they reach the outer surface. In *Chonetes* Mr. Young says the inner series of perforations seen on the interior surface of the valves are very much after the style of those visible on *Productus;* but that observers may be deceived when the specimens they are examining have been decorticated or have had the outer surface of the shell eroded by weathering. On specimens of *Chonetes Laguissiana*, De Kon., where the outer surface of the exterior of the valves is well preserved, he has observed also a series of minute perforations on the ribs, but which penetrate to a very small distance only. In the species of this genus, as in *Streptorhynchus*, *Strophomena*, and *Leptæna*, Mr. Young found that the perforations in all these genera are quite different from those of *Terebratula* and *Orthis*, which pass through the whole thickness of the shell. In the former the perforations slant inwards and upwards from the interior towards the beak of the shell. The laminæ of the shell also show, as Dr. Carpenter terms it, an infundibular arrangement around the punctures. The interior surface of the valves of *Streptorhynchus* is closely and strongly punctate or rather pustulate.

The shell-substance of *Lingula* Professor King believes to be almost entirely com-

posed of keratode with a subordinate portion of phosphatic calcareous matter. The shell-structure of *Lingula* and *Discina* has been likewise studied by Dr. Gratiolet in his admirable memoir, "Études anatomiques sur la Lingula anatina.'[1] Therein he mentions that "the structure of the valves in the *Lingulidæ* appear at first sight to differ much from that of the *Terebratulidæ*, but a more attentive examination reveals analogies at first sight unexpected. Two distinct elements exist in the shell of *Lingula*, the one corneous and the other testaceous; they occur in thick layers alternating from the convex to the concave surface of the valves, commencing with a superficial corneous one. These layers are not, however, of equal thickness throughout. On the convex side the thickness of the horny layers is greater towards the outer surface of the shell, while on the visceral or inner surface, the testaceous elements predominate. They are of especial thickness at the level of the posterior angle of the rhomb. The thick testaceous layers are separated by thin corneous ones which thin out at certain points. This arrangement gives an amount of opaqueness to the central portions of the valves, while the outer edges, where the horny substance predominates, are semitransparent. The structure of the testaceous layers simulates that of the *Terebratulidæ;* they are crossed by numerous microscopic canals, which are traversed by extremely delicate striæ, recalling the chains formed by the prismatic elements of the shell in the *Terebratulidæ*. This description applies equally to *Discina*, but in this last the calcareous predominates greatly over the horny portion."

When alluding to the shell-structure of *Crania* Mr. E. Deslongchamps says that it is peculiar "that the valves are in reality formed of two fitting layers, the upper one being compact, while the lower one, on the contrary, shows us a multitude of horizontal striæ of an extreme delicacy, which are no doubt due to an excessive division of the fibrous element. These striæ are crossed by a great number of small canals, which are disposed in an irregular manner and do not pass through the entire thickness of the valve, but terminate in a point at their extremity. To this arrangement of shell-structure he gives the name of channelled limestone (calcaire caniculé)."[2]

Dr. Johan T. Van Bemmelen in two very able memoirs,[3] published in 1882 and 1883, "On the Anatomy of the Brachiopoda," described and illustrated with great minuteness the structure of the shell; and he tells me that his results have been almost the same as those attained by Hancock. In his paper he says that the structure of the shell was investigated by himself by making transverse sections through decalcified fragments. "No communication," he adds, "between cæcal cavities in the mantle-tubules and lacunæ or vessels in the mantle itself was found. The corpuscles in these tubules seemed to be for the greater part nuclei belonging to cells that clothe the walls of the shell-perforations. No openings in the periostracum occurred on the tops of the cæca, which tops showed with perfect clearness the radiating ring of fine striations discovered

[1] 'Journal de Conchyliologie,' tome viii, p. 49, 1860.

[2] 'Paléontologie Française, Brachiopodes Jurassiques,' t. vi, pp. 17, 18, Pl. viii, 1862.

[3] 'Annals and Mag. of Nat. Hist.,' 5th series, vol. ii, p. 379, 1883.

by Carpenter and King. The number of cæca on the same part of the shell-surface in very old and very young specimens of *Waldheimia cranium* was found to be the same. This fact shows that the distance between two cæca does not change with age, and led the author to the conclusion *that no intussusception occurs during the growth of the shell.* The bases of the calcareous prisms were found to be very regularly shaped at the margin of the shell, but (especially in *Terebratula* and *Terebratulina septentrionalis*) they became very irregular towards the older parts. The concentric lines of growth occurring on the outer surface were totally absent on the inner surface, which is explained by supposing the apposition at the margin to stop for some time; the formation of new layers at the whole under surface at the same time continuing. The chief result of the investigation of the *body-wall* (with its pallial lobes) on surface-views and sections was the demonstration of the *non-existence of the lacunary system described by Hancock.* Under the simple epiblastic epithelial layer was found a homogeneous intercellular substance, containing a reticular network of multipolar cells, a 'mesenchymatic' layer. These cells had probably been mistaken by Hancock for a system of lacunary spaces. At the side of the cœlomic cavity the body-wall shows a layer of flat epithelial cells."

I must, however, remark that Hancock's lacunæ have been seen by Mr. Dall in some species, while in others they are invisible and apparently absent; and he adds that this is even true in some individuals of a single species.

Having briefly alluded to the *exterior* of the shell, as well as to its structure, it will be now necessary to notice its *interior* surface; but to this subject we shall have to refer more fully in the sequel.

Mr. P. H. Carpenter remarked when receiving the Lyell Fund ('Q. J. Geol. Soc.,' vol. xxxix, Proc., p. 35)—"I have the strongest conviction (and many mistakes would be avoided were it a universal one) that the only way to understand fossils properly is to gain a thorough knowledge of the morphology of their living representatives. These, on the other hand, seem to me incompletely known if no account be taken of the life-forms which have preceded them." This has been constantly the view I have taken and followed since the time I first began my studies in connection with the Brachiopoda; and I have never lost an opportunity in making myself acquainted with the living forms and their animal, as well as in urging similar investigations to be undertaken by eminent zoologists and anatomists, who were more competent than myself to advance our knowledge in that important subject. How can we understand those varied and complicated processes and impressions seen on the interior surface of the fossil shells of extinct species, if we do not make ourselves acquainted with them and their functions in the living forms? Once acquainted with these, it becomes a comparatively easy matter to interpret them and their functions in their fossil representatives. I have always maintained that the study of the interior characters are of paramount importance in the discrimination or classification of genera and families.

For the present I shall content myself by observing that on the inner surface of

both valves are several well-defined muscular impressions, which vary considerably in position and shape in different genera. They occur either in the shape of indentations of greater or lesser depth, or of variously shaped projections. In the *Trimerellidæ*, for example, some of the muscles are attached to a massive or vaulted platform situated in the medio-longitudinal region of the posterior half or umbonal portion of both valves.[1]

The position, number, and functions of the muscles are different in the *Tretenterata* and the *Clistenterata*. In various species muscles were attached to the hinge-plate, to the cardinal process, or to septa; and our knowledge of this subject has been obtained only after much study of the animal itself in both divisions.

The vascular impressions, differing also in position and shape in different genera and species, are often beautifully displayed on the interior surface of the valves. The ovarian impressions or spaces are also often visible; and indications of the position and shape of the labial appendages, as well as of the mantle itself, have sometimes left imprints on the interior surface of the valves. In addition to these there exists in the interior of the dorsal valve of some genera of Brachiopoda, a variously shaped, thin, calcified, ribbon-shaped lamella or skeleton, which, as stated by Dr. S. P. Woodward, "Supports the brachial membrane, but does not strictly follow the course of the arms. The mode in which the arms are folded is highly characteristic of the Brachiopoda; the extent to which they are supported by a calcareous skeleton is of less importance and liable to be modified by age."[2] So varied, yet in shape so constant to certain genera and species, are these laminal apophyses, that they have served as one of the chief characters in the determination of both recent and extinct genera.[3] The apophysis, or loop, as it is called, is more or less developed. In some genera it extends to upwards of three fourths of the length of the shell, as in *Waldheimia;* but in others it is short, and projects but little beyond the hinge-line. In some genera it is attached only to the hinge-plate, as in *Terebratula, Waldheimia,* &c.; in others, to a central longitudinal plate or septum, as in *Terebratella,* &c. In certain families the apophysis presents the form of two spirally coiled lamellæ, which nearly fill the interior of the shell; the ends of the spirals being directed outwards or towards the cardinal angles, as in *Spirifera, Athyris,* &c.; or horizontally, the apices facing each other towards the centre of the shell, as in *Glassia.* Again, the spirals are sometimes vertical, their inner sides being pressed together and flattened, with their terminations close together and facing the bottom and centre of the dorsal valve, as in *Atrypa.* The spiral processes are also connected by a more or less complicated system of lamellæ, which have served, in part, as valid grounds for separating into different genera, *Spirifera,*

[1] Davidson and King, "On the *Trimerellidæ*," 'Quarterly Journal Geol. Soc. of London,' vol. xxx, p. 124, 1874.

[2] 'A Manual of the Mollusca,' p. 211, 1856.

[3] In the 'Annals and Magazine of Natural History,' vol. ix, p. 361, May, 1852, I published "A Sketch of a Classification of Recent Brachiopoda based upon Internal Organisation," and gave figures of the loop in different genera.

Cyrtina, Nucleospira, Merista, Whitfieldia, Dayia, Uncites, Athyris, Glassia, Kaysaria, Bifida, Zygospira, Retzia, Atrypa, &c., all of which have been fully described and illustrated in the pages and plates of this Monograph. In the *Rhynchonellidæ*, again, the apophysis assumes the shape of two short, slender, curved lamellæ. Some show large septa and converging plates, as in *Pentamerus;* while in many genera and even families, such as in the *Orthididæ*, *Strophomenidæ*, *Productidæ*, &c., there exist no calcified supports for the labial appendages. That the animal was possessed of fleshy, coiled, labial appendages is amply proved, for in several species, such as *Strophomena rhomboidalis, S. Jukesii*, and others, the interiors of the ventral valves exhibit in a beautiful and unmistakable manner the impressions of the coils of the fleshy labial processes that were in life affixed to the dorsal valve or to some of the soft parts of the animal.

At the period I commenced my Monograph, thirty-four years ago, our knowledge in connection with the internal details above very briefly noticed was exceedingly scanty, incomplete, and often unsatisfactory; and to obtain our present information has necessitated long, persevering, and patient research, in which I have been aided by several palæontologists whose skill and acumen cannot be too loudly commended.

It would not be possible in this brief summary to allude, in detail, to what each observer had done since 1606 towards the advancement of our knowledge, but in order to make up, as far as possible, for this omission, there has been added a "Brachiopod Bibliography," in which references are given to the majority of such works and papers, and which carries the literature of the subject up to the present time. Towards this compilation several friends have contributed their valuable assistance. Omissions, which we regret, are unavoidable.

Development of the Loop.—Previous to 1852 we knew very little with respect to the development of the loop in the *Terebratulidæ*. In 1853 Dr. S. P. Woodward and myself had observed that a modification in the shape of the loop in the genus *Terebratulina* took place from the fry to the adult; for we showed that when it was quite young and up to a certain age the loop was short and simple, as in *Terebratula*, but that with age it was rendered annular by the gradual union of the oral processes. In very young stages, says Morse, the loop is not yet formed, but the future position of the calcareous loop or crura is indicated by a row of irregular-shaped spicula. In the 'Geologist,' vol. iii, p. 144, 1860, Mr. C. Moore published some observations "On the Development of the Loop in *Terebratella*," having previously submitted for my inspection, opinion, and illustration, several very young examples of a small species of *Terebratella* (*T. Buckmani*) he had discovered in the Great Oolite at Hampton Cliff near Bath. I made enlarged drawings which were subsequently badly reproduced in pl. xiii of that periodical. Our observations showed that a certain modification in the loop took place prior to its having attained its final full-grown condition. This I likewise subsequently observed to be the case in several other recent and fossil species. The subject, however, in 1875, was

seriously taken into consideration by Herman Friele,[1] when he pointed out that the skeleton of *Waldheimia cranium*, Müller, and *Wald. septigera*, Lovèn, underwent a peculiar change, the apophysary system exhibiting a much more complicated construction at an early stage of growth than at maturity. In a subsequent paper, illustrated by six well drawn plates, Herr Friele continued his investigations on this important subject,[2] and stated: "Having resumed the study of *Waldheimia*, I have become satisfied that my description given of the young state of the apophysary system and its development was, in the main, correct, *i.e.* the apophysis of *Waldheimia* is at an early stage fastened in a threefold manner; firstly, the lamellæ are connected to the hinge-plate by the crura; secondly, the lamellæ are connected with the septum; and, finally, the reflected part of the loop is connected with the lamellæ and the septum by two vertical walls placed close together. As the shell is enlarged the loop expands in breadth, the united lamellæ split from below upward, dissolve connection with the septum, and the lateral walls vanish. In this representation no correction is to be made; but, besides being now enabled to proceed one step further in the development, I can also replace my earlier simple drawings by better and more complete illustrations." Herr Friele then proceeds to describe in detail each modification assumed by the loop, from its complicated condition up to its simple adult form, in which it is attached only by its crura to the hinge-plate. He adds: "The history of the development of the Brachiopoda has until recently been very little known, and it was not till 1871 and 1873 that Professor Morse published a complete description of that of *Terebratulina septentrionalis*.[3] By comparing the manner in which the formation of the apophysary system takes place in the latter, with the above described in *Waldheimia*, an essential difference is observed; *Terebratulina* proceeds without deviation direct towards the form that characterises the genus; *Waldheimia*, on the contrary, forms first a very complicated loop and passes then to one of a more simple construction."

In the 'Proceedings of the Zoological Society' for 1878, Dr. Gwyn Jeffreys corroborated the observations of Herr Friele; and I likewise noticed, in "Challenger" material, that a similar development in the loop as that observed in *Wald. cranium* and *Wald. septigera* takes place in *Wald. Kerguelensis* and *Wald. flavescens*, and that this is probably the rule in every species of the genus. A similar modification of the loop occurs in *Wald. lenticularis*, a species nearly related to *Wald. Kerguelensis*.

These important questions and investigations relative to the development of the loop in different genera and species are, as it were, a new study, which, when properly followed up, will eventually lead to the most important results. It will now, therefore,

[1] 'Bidrag til Vestlandets Mollusk-Fauna, Christiania, Videnskabs-selskabets Forhandlinger' for 1875, p. 57.

[2] "The Development of the Skeleton of the genus Waldheimia," 'Archiv for Mathematic og Naturvidenskab,' Christiania, 1880.

[3] "Early stages of *Terebratulina septentrionalis*," 'Mem. of the Boston Soc. of Nat. Hist.,' vol. ii, parts 1 and 3.

be very desirable to obtain and examine a large series of specimens of the same species, both recent and fossil, at different stages of development (as has been done by Herr Friele for *Wald. cranium* and *W. septigera*), a study that will repay those naturalists who may be able to procure the necessary material.[1]

Embryology of the Brachiopoda.

During many years the Brachiopoda have been considered as constituting a portion of the sub-kingdom Molluscoidea, and this view is still adhered to by many distinguished naturalists; but, since the study of the embryo of the Brachiopoda has been undertaken by some of our most eminent zoologists, much uncertainty has prevailed and many differences in opinion have been expressed with respect to the true position the Brachiopoda should hold among the Invertebrata.[2]

It will not be possible in this Summary to enter into very minute details in connection with the development of the Brachiopod from the egg up to its adult condition, but the endeavour will be made to give some of the principal results obtained and opinions entertained in connection with the subject, one of such great importance and so ably worked out.

In 1853 Sir Richard Owen, in the chapter "On the Anatomy of the Terebratula," which he kindly added to my General Introduction, briefly described the generative system as well as the egg of *Lingula*, with seven figures. He remarked that the generative organs presented the same form in all the individuals of the different species of *Terebratulæ* examined by him, and that this form corresponded with that of the pallial sinuses in which they seem to be situated. He believes that the individuals of this genus are diœcious, not, as he formerly supposed, simple hermaphrodites. The embryos of *Terebratula*, *Terebratulina*, *Waldheimia*, *Argiope* (*Cistella*), *Thecidium*, *Discina*, and *Lingula* were examined and described.

In 1849 E. Forbes says in his 'British Mollusca,' that in the Brachiopoda the sexes are distinct and that the organs of the sex are attached to the mantle. The ova of *Terebratula*, writes Woodward in his 'Manual of the Mollusca,' p. 212, Ed. 1856, "are developed within large veins, which they accompany as far as the secondary branches. In the *Rhynchonellidæ*, and probably in the *Orthidæ*, the ovaria do not extend to the venous trunks, but occupy large sinuses on each side of the body; in *Discina* and *Lingula* they (or the testes) fill the interstices of all the viscera but do not appear to extend into the mantle." Hancock stated that in *Waldheimia Australis* the genitalia "are formed of thick bands somewhat

[1] Observations on the development of the loop have been published in my "Report on the Brachiopoda dredged by the 'Challenger' Expedition," 'Zoology,' part 1, 1880.

[2] In 1789—1792 Bruguière described the Brachiopoda under the name of "Vers testacés," testaceous worms.

convoluted and branched; they are full of yellow colour, and are thrust into the trunks and main branches of the great pallial sinuses. There are four of these bands, two in each lobe; those in the dorsal lobe are single and occupy the outer or lateral sinuses, extending from behind the attachment of the occlusor muscles to within a short distance of the anterior margin of the mantle; their posterior extremities reach to the perivisceral chamber. The ventral pair extend as far forward as the dorsal, and are double; that is, each forms a loop, the free extremities of which pass into the outer and inner sinuses of the same; the looped portions lie within the perivisceral chamber, at the sides and below the pseudo-hearts or oviducts."[1] The organs themselves, the same author continues, vary considerably in size and "in the extent of their ramifications, chiefly on account, apparently, of their state of development, though not entirely so; as even where the ova are mature there is occasionally a remarkable diversity." Hancock entered minutely into the subject in connection with the reproductive system, and to this the reader is referred. He considered *Lingula* at least to be androgynous or monœcious, and he infers from analogy that both sexes are combined also in the Articulated Brachiopoda.

Prof. H. Lacaze-Duthiers, in his admirable memoir on the 'History of the *Thecidium mediterraneum*[2] treated in great detail of the organs and mode of reproduction. He wrote that, as the Brachiopoda known up to the present time are all attached, the connection of the two sexes becomes impossible, and that in this group the conditions of fecundation must be left to hazard. The genital glands of the two sexes, he says, are borne by different individuals; and he had ascertained that in *Thecidium* the separation of the sexes is shown by a constant character or difference in the adult shell. "In vain have I sought for differences in the shell in other genera and species which would enable me to find out which shell belonged to a male or to a female individual." This would appear to be different in *Thecidium*; however the distinguished French zoologist seems to have proved that hermaphrodism does not exist in *Thecidium*, as the distinction of the sexes is as defined as in the more highly organised animals.

Next, in 1872, came the admirable researches of Prof. E. Morse on the development of *Terebratulina caput-serpentis*.[3] He mentioned that to Oscar Schmidt is due the credit of giving the first figure of a larval Brachiopod (in the 'Zeitschrift für Naturwissenchaften,' 1854, p. 315). Therein he gives a description of the embryo of some species of *Terebratula* collected in the North Sea, with a simple figure. In this the embryo shows a deep constriction in the centre, the free or cephalic portion being wider than the posterior half, which is abruptly truncated at the end; and he infers, and rightly too, that at this end the embryo becomes attached. Prof. Morse described the eggs and their mode of development with admirable preciseness and detail; and added, "The eggs are discharged from the

[1] "On the Organisation of the Brachiopoda," 'Phil. Trans.,' vol. 148, p. 817, 1858.

[2] 'Annales des Sciences naturelles,' 4th ser., vol. xv, p. 302, 1861.

[3] "On the Early Stages of Terebratulina septentrionalis ('Boston Soc. of Nat. Hist.,' vol. ii, 1869; 'Annals and Mag. of Nat. Hist.,' 1871, p. 414; "On the Oviducts and Embryology of Terebratulina" ('Ann. Journ. of Sc. and Arts,' vol. iv, 1872; "Embryology of Terebratulina" ('Boston Soc. of Nat. Hist.,' 1873).

anterior margin and drop just beyond the pallial membrane, hanging in clusters from the setæ, presenting the appearance of a white powder, though with a simple lens the individual eggs are plainly seen. They are opaque and spermaceti-like in colour. In the course of a few hours they become clothed with cilia. The sexes are separate." He could not, however, ascertain whether the eggs are fertilised after they have left the parent or before. In some cases the eggs did not appear to be locomotive until two or three days after their discharge, while in other cases they become active on the day of their discharge.

Fritz Müller, in 1860 and 1861, contributed some observations on the embryo of *Discina*;[1] and M'Crady in 1860 offered the first description of the larva of *Lingula*.[2]

In 1874 appeared an admirable memoir by Prof. Kowalevsky 'On the Development of the Brachiopoda,' published at Moscow, and of which MM. Oehlert and Deniken have given an excellent summary in French.[3]

Dr. J. F. Van Bemmelen, in his memoirs on the structure of the shells of Brachiopods and Chitons,[4] &c., says that in the species he has investigated (*Terebratula vitrea*, *Terebratulina septentrionalis*, *Waldheimia cranium*, and *Rhynchonella psittacea*), the sexes are separated, and he supposes the impregnation to take place in the sea-water, into which the eggs and spermatozoids are evacuated through the genital tubes, because he cannot believe spermatozoids to enter the body-cavity of females by the small external openings of these ducts.

The embryos of the following genera and species have been carefully examined, and it has been abundantly shown that the embryo assumes a series of well-defined stages in its development. Little, however, was known with respect to the embryology of the Brachiopoda previous to the publication of Prof. Lacaze-Duthiers' admirable memoir, to which we have already referred. Thus we have knowledge of the embryology of—

Terebratulina septentrionalis, by Oscar Schmidt, Morse, Kowalevsky, M'Crady.

Terebratula vitrea and the variety *minor* by Kowalevsky, Bemmelen, Oscar Müller.

Waldheimia cranium, by Bemmelen.[4]

Argiope (*Cestella*) *neapolitana*, by Lacaze-Duthiers, Kowalevsky.

Thecidium mediterraneum, by Lacaze-Duthiers, Kowalevsky.

Rhynchonella psittacea, by Bemmelen.

[1] "Beschreibung einer Brachiopoden-Larva" (Reichert und Bois-Raymond, 'Archiv für Anatomie und Physiologie,' p. 72, 1860, and Wiegmann's 'Archiv,' p. 53, 1861.

[2] "Notice on a Larval Brachiopod," 'Proc. Elliot Soc. of Natural History of Charleston S. C.,' 1860. These authors showed that the larvas of some Brachiopoda swim in a free condition, have a digestive tube, dark or ocular spots, and auditive vesicles. In his admirable memoir on the 'Embryology,' Prof. Morse publishes a translation of Fritz Müller's paper.

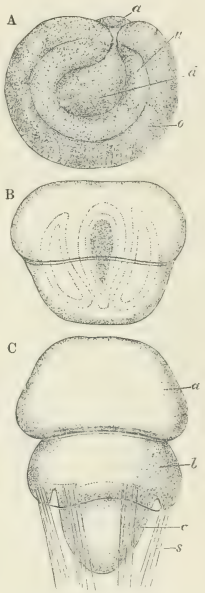
[3] 'Observations sur le developpement des Brachiopodes," 'Archives de Zoologie exp. et gén.,' 2nd serie, vol. i, 1883.

[4] 'Over den bouw der Schelpen Van Brachiopoden en Chitonen,' 1882; and "Untersuchungen über dem anatomischen und histologischen Bau der Brachiopoda Testicardinia" in 'Jenaische Zeitschrift für Naturwissenschaft.,' 1883; and 'Annals and Mag. of Nat. Hist.,' 5 ser., vol. ii, p. 379, 1883.

Lingula (*Glottidia*) *pyramidata*, by Morse, Brooks.[1]

Discina, sp., by Fritz Müller.

Kowalevsky has described and illustrated in great detail the development of *Argiope* (*Cistella*) *Neapolitana*. He states that the eggs, after having detached themselves from the ovary, fall into the general cavity of the body, enter the oviducts by the funnel-shaped opening of these organs, and pass into the incubatory pouches, situated on the ventral lobe of the female individual, and where they are developed. He is of opinion that the fecundation must, without doubt, be accomplished either during the passage of the egg along the oviduct, or in the general cavity.[2]



A, B, C, *Argiope Neapolitana* (after Kowalevsky).

A. Egg after the invagination of a part of the blastoderm: *d*, cavity formed by the invagination; *a*, orifice of the cavity; *o*, exterior layer (upper); *u*, interior layer.

B. The embryo divided into two segments.

C. Embryo, of which the folding of the mantle already covers a part of the caudal segment: *a*, cephalic segment; *b*, thoracic segment; *c*, caudal segment; *s*, bundles of bristles.

First period.—*From the commencement of the development of the egg up to the moment when the larva fixes itself.*

In the less advanced state, Kowalevsky has observed that the egg presents the aspect of a vesicle, of which the sides are composed of little cylindrical cells surrounding a small cavity. Soon after a portion of the blastoderm becomes invaginated (Fig. A), the extremities of the gastrula approach each other and leave between them only the place of an opening. At this moment the embryo presents two layers of small cells; one of them is the outer layer of the blastoderm, the other the inner layer; it is at the expense of this last that the middle segment as well as all subsequent modifications are formed.

In the next stage, the cavity divides itself into three lobes (one median and two lateral), which communicate at the part the nearest to the orifice. This orifice is connected with the median lobe by the means of a narrow canal, of which the walls present two small prominences formed of small cells distinctly differentiated. Soon after the embryo divides itself transversely into two segments, the one upper and large (cephalic segment), the other narrower and more conical (caudal segment) (Fig. B). At this period the three lobes of the internal cavity separate themselves the one from the other and form three isolated cavities. The median cavity presents at its posterior portion so great an approximation to its walls, that these last appear as partition. At the anterior part the median cavity is surrounded, in addition to its own walls which are formed of cylindrical cells, like the envelopes of

[1] Chesapeake Zoological Laboratory, Scientific Results, Baltimore, 1879.

[2] We have considered it desirable to translate here a portion of MM. Oehlert and Deniker's excellent summary of Kowalevsky's memoir, as so few are able in this country to read the Russian language.

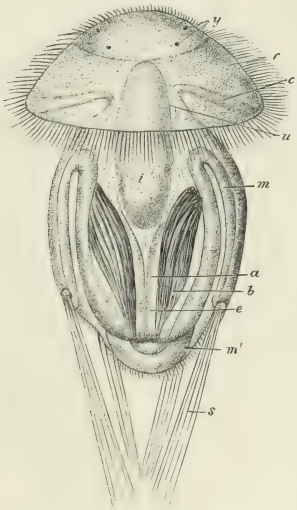
the other cavity, by a second layer of small, pale-coloured hexagonal cells, which for some distance are in direct relation with the external layer. (Kowalevsky is unable to explain either the origin or signification of this layer.)

Afterwards the median cavity transforms itself into a digestive tube; perhaps these walls form the intestino-glandular layer. The lateral cavities constitute the general cavity of the body; the interior part of their walls produces the mesentery and perhaps some muscular fibres (intestino-muscular layer of the middle layer); the outer part gives birth to the principal muscles.

Next follows a stage wherein the embryo is divided into three segments (Fig. C); the last appearing segment being the median segment or thoracic segment, which has probably been formed by a division of the caudal segment.

The thoracic segment carries four bundles of bristles, of which two are median and two lateral; each bundle is composed of four or five immovable cylindrical and blunt bristles (Fig. C, p. 303).

D



Advanced stage of larva of *Argiope Neapolitana* (swimming freely).

y, eyes; *r*, edge of the cephalic segment; *w*, cylindrical part uniting the cephalic to the thoracic segment; *m*, mantle; *i*, rudiment of the intestine; *e*, mesentery; *m'*, a part of the mantle covering the caudal segment; *a*, muscle going from the dorsal to the ventral part of the valve; *b*, abdominal muscles; *c*, muscles of the cephalic segment; *s*, bristles.

At the succeeding stage the mantle commences to appear under the form of two folds covered with hairs, which rise from the ventral and dorsal side of the thoracic segment.

Soon this folding of the skin (future mantle) becomes developed and partly covers the caudal segment. The bristles, which are then situated on this fold, become larger and pass beyond the caudal segment. At the same time appear two pigmentary spots on the dorsal side of the cephalic segment.

The author has not been able to observe the phases intermediate between this stage and that where the larva issues from the incubatory pouch and swims freely. At this period of the larval development, the mantle covers all the caudal segment, whilst the cephalic segment, which is covered with vibratile cilia, assumes an umbrella-shape, at the summit of which may be distinguished a portion more or less separated from the rest (head), and which carries four eyes (*y*, Fig. D); this head corresponds to that which M. Lacaze-Duthiers has described in *Thecidium*.

The digestive tube is almost entirely confined to the thoracic segment; its anterior portion, however, penetrates a little into the cephalic segment. This last connects itself

slightly to the adjoining segment by the means of an organ of cylindrical shape. Kowalevsky could not detect any traces of the nervous system.

The muscular system of the larva is represented by delicate fibres, which pass from the posterior portion of the intestine to the lateral walls of the thoracic segment.

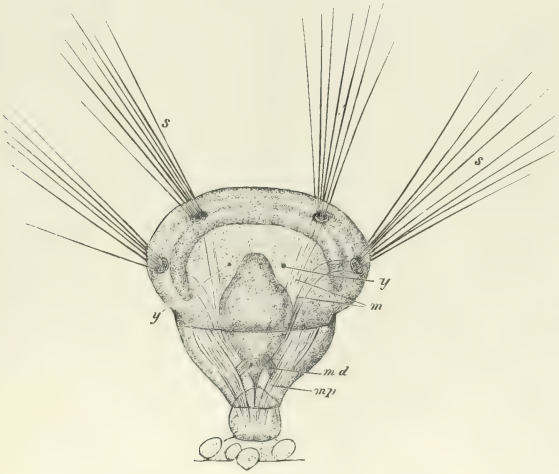
The mantle is composed of two layers, an external formed of pavement-epithelium; the other an internal consisting of small cylindrical cells. Between these two layers there are very delicate muscular fibres. The edges of the mantle always carry on the ventral side four bundles of bristles, which already existing in the preceding stages, have grown and increased in length.

At this stage the larva swims freely by the help of its vibratile cilia and by slight movements of the head. At the approach of danger it vigorously contracts itself and erects its bristles in all directions. All these movements recall those of the larvæ of the *Annelidæ* and in particular of those of the *Mitraria*.

The larva after having swam for some time fixes itself; and then commences the second stage of its development.

Second Period.—The fixing of the larva to marine objects is effected by the means of a sticky substance formed by the caudal segment; as soon as fixed the larva begins to turn up its mantle and to raise it above its head, so that in a little time the mantle envelops the whole of the cephalic segment. On account of this folding

E



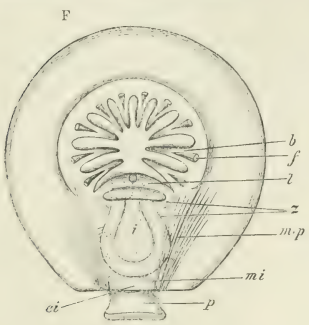
Argiope (*Cistella*) *Neapolitana*, after Kowalevsky.

The larva after it has become fixed; *s*, bristles; *y*, eyes; *m*, muscles going to the bases of the bristles; *md*, adductor muscles; *mp*, ventral peduncular muscles. The thoracic segment is the part carrying the four bundles of bristles, *ss*, of which two are median and two lateral.

over of the mantle the external part of each lobe becomes internal, from which it results that the bristles that were on the exterior surface find themselves carried inside, and then, becoming unnecessary, drop off in a few days' time. It is therefore seen by this, that it is not these bristles which produce those that border the mantle of the adult animal; anyhow, *Argiope* is not provided with marginal bristles or setæ, but in those species that possess them they are the result of a new formation and of a much later period.

The lobes of the mantle gradually become invested with a thick and ridged cuticle which permits them to move only in a vertical direction. At the same time the caudal segment is transformed into a peduncle, and the muscles that went from this last segment to the thoracic segment become ventral peduncular muscles, the pair of middle muscles changing into divaricators. The head assumes a spherical shape, and the eyes continue to exist.

At the next stage, the thoracic segment grows smaller in size, the digestive canal becomes round, and there is produced in the cephalic segment a funnel-shaped pit which descends towards the canal. This depression is in all likelihood the œsophagus (gullet). It should be observed that the characteristic feature at this period consists in the appearance of the branchiæ; these come into existence in the form of four nipples directed inwardly and situated on a thickening of the dorsal lobe near its border.



Larva of *Argiope Neapolitana*.

Condition previous to the formation of the shell. *b*, branchiæ; *f*, muscular bundle of the branchiæ of the inner side; *t*, head and œsophagus; *z*, divaricator muscles; *i*, stomach; *mp*, ventral muscles of the peduncle; *mi*, muscles going from the ventral valve to the upper part of the dorsal valve; *ei*, internal envelope; *p*, peduncle.

The dorsal thickening soon assumes the form of an almost circular swollen ring, and the number of the branchiæ amounts to ten (*b* of woodcut F). In the interior of the swollen ring there exists a cutaneous layer, which seems to support all the branchial apparatus, and which is pierced by a hole opposite each of the branchiæ. The branchiæ, which are only prolongations of the swollen ring, are covered with vibratile cilia, and are provided with flexible muscles and become erected through their own elasticity. The extremities of the branchiæ converge towards the opening of the mouth.

At the following stage there are present twelve tentacles; and at the same time the shell is formed, but no tubular perforations are yet seen. Of the following stages Kowalevsky has been able to trace but one, that of the gradual formation of the shell.

Lacaze-Duthiers' admirable description of the development of *Thecidium* was a great advance to our knowledge. He showed that the embryo and larva, as in *Argiope*, pass through different stages previous to reaching the full grown condition.

The researches also of Prof. E. Morse on the embryology of *Terebratulina septentrionalis* have added new information. He states that the embryo presents a series of well-defined stages, which he describes and illustrates with minute detail. "In the first stage the embryo becomes expanded at one end; the segments are barely indicated; the posterior end is the widest; the anterior portion is ornamented with a conspicuous tuft of long cilia, so peculiar to the embryos of many worms. The embryo is also clothed with vibratile cilia, and in this condition slowly moves along the sea-bottom (one placed in a dish did so). In the second well-marked stage the embryo is divided into two prominent segments; these expand and contract upon each other slightly, and the cephalic segment has the power of partially bending from side to side. In this stage the embryo is most active, swimming rapidly in every direction and turning abruptly about. The œsophagus also becomes dimly defined. In the third stage the peduncular segment is developed, and projects from the posterior portion of what can now be called the thoracic segment. In this stage the embryo either remains immoveable upon the bottom or slowly moves about. (In two cases delicately barbed setæ, to the number of thirty-five, were observed projected backward from the peduncular segment.) In the fourth stage the embryo becomes attached by means of its peduncular segment. The embryo is still clothed with cilia, though the long pencil of cilia has disappeared. The head is closely drawn to the thoracic segment, which becomes wider in transverse diameter so as nearly to hide the peduncle. In the fifth stage the thoracic ring commences to fold, or turn upward, upon opposite surfaces of its circumference, so as to gradually enclose the head. One fold, being made slightly in advance of the other, represents the larger or ventral valve. In this stage appear clusters of barbed and deciduous setæ upon the anterior margin; and in a later portion of this stage the first hardened areas of the dorsal and ventral plates make their appearance, and their cirri appear as blunted papillæ about the mouth. In the sixth stage the shell becomes rounded, the peculiar scaled structure makes its appearance, and the formation of the tubules perforating the shell, and of permanent setæ takes place." The author adds further that "In another memoir I hope to present the characters of the genitalia of the Brachiopoda. I will state here, however, that the eggs not only fill the large pallial sinuses, but hang in clusters from the genital band; from these parts they escape by dehiscence, and float freely in the perivisceral cavity. . . . . The eggs are not uniform either in shape or size." Professor Morse then describes in detail each of the stages, but space will not allow of his elaborate investigations being proceeded with, these would demand numerous illustrations. Professor Morse mentions that he was fortunate in observing a very young example of *Terebratulina septentrionalis* in motion. "The animal whirled quickly on its peduncle; when at rest the shells were always closed and rested on the rock, from this position it turned slowly more than half way round, raising the body at the same time almost erect; this movement being completed, the valves would very slowly open, and the cirri expand as if to perform a grasping motion; in no case, however, were they projected beyond the margin

of the valves. The cilia lining the cirri produced gentle currents in the water. In this position, with the valves widely open and cirri expanded, the animal will remain motionless for twenty or thirty seconds, and then, with an abrupt closing of the valves, suddenly assume its first position. In watching these motions for a long time, one could not help being impressed with the fact that caution was evidently indicated in the slow and careful movements made in elevating and opening the shell, while the prompt closing of the valves and the alert manner in which the animal regained its first position seemed to show that food had been secured and further caution was unnecessary."

Dr. Gwyn Jeffreys[1] writes:—In the fry-stage the little creature can creep and swim, but after quitting the embryonic state it becomes invariably and permanently fixed to other substances, being incapable of any other motion than making a half turn round the peduncle or pivot. This is so with respect to the *Terebratulidæ*.[2]

The development of Lingula has been minutely and ably described by Prof. W. K. Brooks. He alludes to Prof. J. McCrady having given a brief description (from memory) of the swimming larvæ of *Lingula*, without tracing in detail the transformation into the adult.[3] Prof. Brooks says that the free-swimming embryos of *Lingula pyramidata*, Stimpson, are met with in great abundance at Fort Wool from about the middle of July to the middle of August; that the changes undergone by the larva during development are gradual, and do not involve any marked metamorphosis. "The larva is enclosed between two orbicular flattened valves, which are not articulated to each other, but are free around the entire circumference. The dark-coloured, somewhat opaque, flask-shaped digestive organs occupy the centre of the cavity of the shell, and are in contact above and below with the integument which lines the valves. Around the digestive organs is a body-cavity bounded externally by the integument, which is continuous with the mouth above and below, and is bent downwards at right angles to the valves to form the body-walls. On the sides of, and behind, and in front of the body, there is a capacious mantle-chamber, which is open around the entire circumference. The mouth opens in the centre of a broad, flat, nearly circular disk or lophophore, around the margin of which are the ciliated tentacles. The plane of the lophophore is not at right angles to the long axis of the body, but inclined so as to be nearly parallel to it. The tips of the tentacles may be extended beyond the edges of the valves and thus form a swimming apparatus, like the velum of a mollusk, by the aid of which the larva floats in the water or rises slowly to its surface."

[1] Brit. Conch., vol. 2, p. 7, 1863.

[2] For many useful details see also Balfour's 'Treatise of Comparative Embryology,' vol. i, 1881.

[3] A notice of a larval Brachiopod, 'Proceedings of the Elliott Soc. of Nat. Hist. of Charleston.'

Affinities of the Brachiopoda.

Before describing the soft parts of the adult Brachiopod it will be desirable to say a few words with respect to the *position and affinities of the Brachiopoda,* as these have been chiefly drawn up from embryological considerations.

Milne Edwards some years back separated the Mollusca into two divisions, *Mollusca* and *Molluscoidea,* and in the last division he placed the *Brachiopoda, Polyzoa,* and *Tunicata,* an arrangement that has been followed by many naturalists.

Although the greater number of zoologists have admitted the close connection of the *Polyzoa* and the *Brachiopoda,* some considerable doubt has been expressed with respect to the affinities and position of the latter to the *Tunicata;* moreover, strenuous efforts have been made by such excellent observers as Japetus Steenstrup, Morse, Kowalevsky, A. Agassiz, and others, to demonstrate that the affinities of the Brachiopoda and Polyzoa are with the worms, and that they should form a division or two divisions of the Annulosa, and be placed close to the Annelidæ. In his review of Kowalevsky's admirable memoir on the embryology of *Argiope, Thecidium,* and *Terebratula,* Alex. Agassiz observes:[1] "The close relationship between the Brachiopoda and the Bryozoa (Polyzoa) cannot be more fully demonstrated than by the beautiful drawings on pl. v of Kowalevsky's History of *Thecidium.* We shall now have at least a rational explanation of the homologies of the Brachiopoda; and the transition between such types as *Pedicellina* and *Membranipora* and other incrusting Bryozoa is really explained from the embryology of *Thecidium.* In fact, all incrusting Bryozoa are only communities of Brachiopods, the valves of which are continuous and soldered together, the flat valve forming a united floor, while the convex valve does not cover the ventral valve but leaves an opening more or less ornamented for the extension of the Lophophore."

I do not know, however, how far Prof. A. Agassiz is justified in stating that Kowalevsky admits the close affinity of the Brachiopoda and Polyzoa, for it is stated in MM. Oehlert and Deniker's analysis of the Russian author's work:—"Let us first consider the Polyzoa. The works of Nitsche, Claparède, Mestchnikoff, Schneider, Uljanin, and Kowalevsky show that these last-named animals are very different from the larvæ of Brachiopods; nevertheless the family of the Pedicellinæ, to which the genus *Loxosoma* is attached, displays some affinities towards them. The larva of *Loxosoma,* which is in effect formed, as the larva of Brachiopoda, of three segments of which one bears the double fold of the mantle, is fixed in a similar manner by its caudal segment, which is afterwards transformed into a peduncle. But the family of Pedicellinæ is still too little studied and the dissimilarities of the Brachiopoda with the other Polyzoa are so marked that it seems difficult to establish, as Huxley desires it, a parentage between these two types." Miss A. Crane, a zealous naturalist, who has given some

[1] Silliman's 'American Journal of Science and Art,' 3 series, vol. viii, p. 471, for 1874.

attention to the study of the Bryozoa, in her article "Brachiopoda and Bryozoa" in 'Cassell's Natural History,' vol. v, p. 280, 1881, says: "It is evident, therefore, from embryological development and adult organisation that the Brachiopoda and the Bryozoa are so closely allied as to form a very natural group, and thus they are classed by the majority of authors. With regard, however, to the exact position in the animal kingdom to be occupied by the group thus restricted, opinions are far less unanimous; for it is also certain that in the earliest stages of growth the Brachiopoda and the Bryozoa betray no molluscan characters. In fact they present such close resemblances to similar stages of some Worms that such embryological authors as Steenstrup, Morse, Kowalevsky, and Agassiz deny their right to admission to the molluscan type. Prof. Morse deduced the same conclusion from observations of the habits and structure of full-grown *Lingulæ*; but other Zoologists consider these structural affinities merely as throwing light on the geological ancestry of both of these coeval types of organisms."

With respect to the *Tunicata*, we are reminded by Morse that Kowalevsky, Kupffer, Schultze, and others assign to them a position at the base of the vertebrate series through the affinities of some of their forms to *Amphioxus*, as well as their singular embryological relations to the Vertebrates. Gratiolet states likewise that the *Tunicata* are in no way related to the Brachiopoda; and Hancock, in 1870, expressed himself to me by letter as follows:—"Of late years I have gradually inclined to the opinion that the Brachiopoda are not so closely related to the Tunicata as we at one time thought. I am busily engaged in working out the Tunicata, and they seem to me to be very intimately connected with the Lamellibranchs. I am disposed to consider that there is a considerable hiatus dividing the Tunicata from the Brachiopoda and the Polyzoa or Bryozoa, and that the latter two groups should be included in the *Molluscoidea*. If, therefore, Morse can establish his doctrine, it will relieve me of some little difficulty, inasmuch as it will militate against Huxley's view that the branchial sac of the Ascidian is the homologue of the pharynx of the Polyzoa; my idea being that the branchial sac is the true representative of the gill-plaits of the Lamellibranch, and has nothing to do with the pharynx of the Polyzoon. There are some characters of the Brachiopoda that are very puzzling."

It is therefore evident that the dismemberment of the Molluscoidea must be considered necessary, and that, at any rate, we cannot place the *Brachiopoda* and the *Polyzoa* in the same division with the *Tunicata*.

The Brachiopoda have been considered by Gratiolet and some others as allied to the Crustacea in respect of their vascular system, and not to the Mollusca nor to the Tunicata.

Prof. Morse reminds us also that thirty-five years ago Prof. J. Steenstrup had not only recognised the Brachiopoda as worms, but had placed them near the tubicolar Annelida.[1]

Lacaze-Duthiers separates them from the Acephala mainly on account of their

[1] "Om Anomias stilling til Meislingerne og Terebratulerne" 'Skandinavian Naturf. Förhandl.,' 1847 ('Proc. of the Royal Danish Academy').

embryonic character, remarking that the difference in this respect between the Brachiopoda and Acephala is as great as between the latter and the Gasteropoda.

It would not be possible here to enter into the numerous and elaborate details given by those zoologists in support of their views, and the reader must therefore refer for more ample information to Prof. Morse's several papers upon the subject, and especially to the one "On the Systematic Position of the Brachiopoda," published in the 'Proceedings of the Boston Society of Natural History,' vol. xv, 1873, as well as to that of Kowalevsky in 1875, and to which we have already referred.

The second memoir of the Russian zoologist, says A. Agassiz, "is a very complete history of the development of the Brachiopods, strikingly in accordance with the views of Morse on the affinities of the Brachiopods with the Annelids. The homology between the early embryonic stages of *Argiope* with the known Annelid larva is most remarkable; and the resemblance between some of the stages of *Argiope* figured by Kowalevsky, and the corresponding stages of growth of the so-called Lovèn type of development among the Annelids is complete. The number of segments is less, but otherwise the main structural features show a closeness of agreement which will make it difficult for Conchologists hereafter to claim Brachiopoda as their special property. The identity in the ulterior mode of growth between the embryo of *Argiope* and of *Balanoglossus*, in the Tornaria stage, is still more striking; we can follow the changes undergone by *Argiope*, while it passes through its Tornaria-stage, if we may so call it, and becomes gradually, by mere modification of the topography of its organs, transferred into a minute pedunculated Brachiopod, differing as far from the Tornaria-stage of *Argiope* as the young *Balanoglossus* differs from the free-swimming *Tornaria*. In fact the whole development of *Argiope* is a remarkable combination of the Lovèn and Tornaria types of development among Worms. Kowalevsky's paper also includes the history of a less vermiform type of development,—that of *Thecidium* and of *Terebratula*, in which the observations of Kowalevsky fully agree with the previous well-known memoirs of Lacaze-Duthiers on *Thecidium*, and Morse on *Terebratulina*; and it certainly is a striking proof of the sagacity of Morse to have announced so positively, from the history of American Brachiopoda alone, the vermiform affinities of the Brachiopoda, proved, by the development of *Argiope*, in Kowalevsky's paper."

No one can doubt that the Brachiopods and Amphitrites possess several important characters in common, after perusing the admirable observations upon the subject contained in Prof. Morse's memoir; but at the same time, as was remarked to me by Prof. Verrill, almost any invertebrate group may be annelidelized by overrating certain points of its affinities; and it seems to me that one must not place entire confidence in any classification which is founded, to so great an extent, on embryological character.

The shell, so important a feature in all the Brachiopods, but absent in Worms, is considered by some zoologists, who contend for the worm affinities, to be a character of but small importance, and they appear to lose sight of the great differences that exist

between the full-grown Brachiopod and the Worm. The Brachiopoda constitute a large and well characterised and distinct class or division among the Invertebrata, far too important to be, as some have suggested, a simple division of Annelida. Their position is lower than the Mollusca, and they form a well-distinguished order between these last and the Annelidæ. The setæ do not appear to be a constant character, and the tendinous peduncle of the Terebratulidæ seems very different from the annulated structure which Morse describes in *Lingula*. It appears, according to Jeffreys, to closely resemble the peduncle of a species of *Anomia* (*A. patelliformis*); *Lingula* being moreover an aberrant form. Morse does not, however, fail to observe "in considering the assemblage of remarkable characters in the Brachiopoda we must recognise in them a truly ancient type. Thus while we do not find them in all their characters resembling any group of Worms, I have endeavoured to show that all their features, to a greater or lesser degree, are shared by one or other of the various groups of Vermes, with one or two features of the Arthropods." Morse concludes his elaborate series of observations by stating that we must regard the Brachiopods as *ancient cephalised Chætopods*, while *Serpula*, *Amphitrite*, *Sabella*, *Protula*, and others, may be regarded as modern (later) cephalised *Chætopods*.

In the general summary of Kowalevsky's memoir by MM. Oehlert and Deniker, 1883, it is stated, "Let us now take up the other classes of Worms, and we shall find a very great resemblance between the Brachiopods and the annulose worms (Chætopods). The larvæ of the Brachiopod have, as those of the Worm, three segments; and, as with these last, they have neither velum, nor foot, nor shell, and are segmented.[1] In the cephalic or caudate segments that first appear, and between which afterwards appears the thoracic segment, the only difference consists in that, with the Brachiopods the development stops at this moment, whilst with the Worms new segments come to be added after the intercalated segment. The bundles of bristles have arranged themselves in a similar manner in the one as in the other larva; they are present only in the thoracic segment, and are wanting on the cephalic segment. It is only on account of a subsequent development that these bristles find themselves carried back on the mantle of the Brachiopod: at this period their disposition and their movements offer the greatest resemblance with those of the bristles of *Mitraria*. The absence of bristles on *Thecidium* is explained by the small development of the ventral side, which is due in its turn to the absence of a peduncle. The existence of bristles during the larval period of the Brachiopoda has a paramount importance; they are not found in the Molluscs, nor Echinoderms, nor even in other Worms besides the *Chætopods*, facts seeming to demonstrate, in an evident manner, the relationship of these last with the Brachiopoda. The analogy is not limited simply to exterior resemblances, but they exist also in the interior structure. Let us

[1] Brooks considers that the Brachiopoda are representatives of the highest specialised branch of *Polyzoa*. The segmentation observable in *Chiton*, *Pneumodermon*, and *Dentalium* is absolutely superficial.

take the digestive tube: sections of larvæ of Chætopods (for example *Nerine*) show that the intestinal canal is immediately applied to the dorsal wall of the body, exactly as in a larva of a Brachiopod; and in the adult condition this canal is fixed by two mesenteries, the one ventral, and the other dorsal, absolutely as in the adult Brachiopod. The muscular system offers us, besides some dissimilarities, marked analogues. If Kowalevsky has been unable to trace, either in the larva of the Brachiopod or in the adult animal, the homologues of the circular muscles of worms, on the other hand he has seen that the muscles which pass to the bristles in the larva of the Brachiopod, and which at a later period become the occlusors, have their homologues in Worms; likewise the ventral muscles of the larva, which later on are transformed into peduncular muscles, and the dorsal muscles of the peduncle, have, as homologues, the ventral and dorsal muscles of Worms. As to the divaricators, it is difficult to find for them homologues in the muscles of Worms, unless, however, they correspond to the muscles of the segments of the Worms, the more so since they are always situated on the posterior side of the thoracic segment. The Russian author abstains from endeavouring to establish any comparison with respect to the nervous system of the Brachiopod and the Worm.

"We find the same analogies in the genital organs, the structure of the ovaries, suspended by the aid of a mesentery, and the shape of the oviducts, all so similar to the segmented organs of Worms; all these characters indicate a relationship between the two types. With respect to the branchiæ, we have seen that they are always formed on the dorsal side of the mantle; one might therefore, perhaps, homologize them with the dorsal branchiæ of the Dorsibranchiates (*Eunice, Nerine*). On the other hand, as in *Thecidium*, the cephalic segment enters into the formation of the branchiæ. These last might, perhaps, be homologues of those of the Cephalobranchiates; anyhow, this differentiation has no importance, and in both cases, whether they are dependencies of the head or of the mantle, one can always compare them with the branchiæ of Annelid Worms.

"The most embarrassing part is the shell, for the tubes that envelope tubicolous worms cannot be assimilated to it, as they are completely independent of the body of the animal. There exist, however, certain analogies between the tubular canals of the shell and the integument of the Worm; likewise, the prolongations of the mantle which fill these canals present, after the dissolution of the shell in acid, a great resemblance with the prominences which are seen in the gelatinous and subcutaneous layer of *Chloræma*. In every respect, therefore, the Brachiopods approach the Worms; but it remains to be determined whether they should form an order or a separate class of Worms. Kowalevsky believes that they are not sufficiently distinct from the annulated Annelida to be separated from them; and after having weighed all the arguments for and against, he says that he believes that the Brachiopoda should be considered simply as an order of Annelida, as they present at least as much resemblance to the *Chætopodes* as the *Discophores*." In this opinion I am unable to concur.

Dall, a distinguished American naturalist, is strongly opposed to the idea of placing the Brachiopods among the Annelida; and in order that the reader may become acquainted with both sides of the question we must refer him to Dall's paper in the 'American Journal of Science' for 1871. Therein he maintains, after a lengthened comparison between the Annelids and Brachiopods, that these last are allied to other groups, including the "Molluscoidea," and, through their combined characters, to the typical Mollusca. He adds the following tabular comparison, which will illustrate the differences in the characters of real value in the several groups:

Mollusca vera.	*Brachiopoda.*	*Annelida.*
Subœsophageal ganglion present; others scattered, not in a subabdominal chain.	Subœsophageal ganglion present; others scattered, not in a subabdominal chain.	Ganglion supraœsophageal; and a subabdominal chain.
Possessing a heart with or without pulsatile vesicles.	Heart and pulsatile vesicles present.	Without a heart, and sometimes without vessels.
Intestine always bent.	Intestine bent.	Intestine usually straight, sometimes bent.
Fixed organically or free.	Fixed organically or free.	Always free or not organically fixed.
Setæ rarely present.	Setæ sometimes present.	Setæ present usually.
With or without organically attached calcareous shells.	With organically attached calcareous shells.	Without organically attached calcareous shells.
Mon- or diœcious, with oviducts.	Mon- or diœcious, with oviducts.	Mon- or diœcious, with or without oviducts.
Always reproducing by eggs.	Always reproducing by eggs.	Reproducing by eggs or fission.
No sexual metamorphosis.	No sexual metamorphosis.	Often with two sexual forms.
Aquatic or terrestrial.	Aquatic.	Aquatic or terrestrial.

Dall adds that it does not seem possible that any modern naturalist should seriously homologize the integument of a Worm with the shell of a Brachiopod. Such a homology is its own best refutation. As for the rest, where is the "hardened integument" of *Planaria*, or the *Trematoda*, or the *Hirudinæ?* Where are the muscles by which they are attached to their "bivalve or multivalve shells? and how are those muscles attached? Homologies and muscles fail in such an emergency."[1]

Stoliczka agrees with the conclusions advocated by Dall; and adds, in vol. iv of the 'Palæontologia Indica, Brachiopoda,' "There cannot be much doubt as to the true Molluscous character of the Brachiopoda, and their proper classification between the Anomiidæ of the Pelecypoda and the Saccopoda and the arm-bearing section of the Ciliopoda."

[1] In 1870 Mr. Morse published in the 'American Journal of Science and Arts,' vol. iv, p. 4, a "Reply to Mr. Dall's Criticism on 'The Brachiopoda, a Division of Annelida.'" I regret I have not been able to make myself acquainted with the contents of that paper.

Prof. W. King,[1] an acute and careful observer, who has made an attentive study of the Brachiopoda, says, "The Palliobranchs have often been associated with *Polyzoa;* but lately Morse has endeavoured to show that they are more closely related to the *Annelida*. There is no doubt he has succeeded in adducing certain points in his favour; but there are so many dissimilarities between the Annelids and the Palliobranchs (or Brachiopods) that it is scarcely to be expected the polyzoonal alliance will be abandoned by those who have contended for it, especially since the discovery of *Rhabdopleura*, a marine form of Hippocrepian Polyzoa. . . . . Although admitting that the Palliobranchs manifest affinities to the Annelids, Polyzoans, and Asterids, I cannot relinquish the idea that they are more closely related to the Mollusca. If they do not possess sufficient distinctive characters entitling them to rank as a more comprehensive division, I would, instead of associating them with any of the groups above mentioned, prefer that they should retain their old position in the sub-kingdom Mollusca, as defined by Cuvier."

In this opinion of Prof. King I concur, for the more I consider the question the more am I disposed to believe that the Brachiopoda should not be classed with the Vermes.

In order to do all the justice possible to the zoologists who have studied the subject under investigation, it will be necessary to allude to a most important and valuable memoir by W. K. Brooks "On the Development of *Lingula* and the Systematic Position of the Brachiopoda," published in the 'Chesapeake Zoological Laboratory, Session 1878, 1879.' At p. 80, Brooks observes that "While most of the more recent writers recognise a pretty close relation between the Polyzoa and the Brachiopoda, some associate them with the Mollusca, others regard them as a related group (Molluscoidea), and others associate them with the Vermes. Huxley, 'Anatomy of the Invertebrate Animals,' p. 468, says: "The acceptance of the view originally propounded by Steenstrup, and so ably urged by Morse, respecting the affinities of the Brachiopoda with the Worms, does not, to my mind, weaken the opinion I have always held as to their affinities with the Polyzoa on the one hand, and with the higher Mollusca on the other." At p. 453 he says: "The higher Mollusks, in fact, form the final term of a series of their own, which commences in the Polyzoa, with animals which have many resemblances to the Rotifera." Claus takes a somewhat similar view,[2] and places the Brachiopoda and Polyzoa together, between the Annelida and Mollusca. Gegenbauer separates the Polyzoa from the Brachiopoda, and places the former group among the Vermes; while of the latter he makes a primary group, which, however, he places near the Annelids.[3] According to Lankester, the Brachiopoda and the Polyzoa are closely related to each other, and are to be associated with the Mollusca; but Lankester's conception of the precise nature of this relationship is different from that of any of the other authors quoted. He does not, like Huxley,

[1] 'Geol. Mag.,' Decade 2, vol. iv, p. 266, 1877.

[2] 'Grundzuge der Zoologie,' p. 821, 1876.

[3] 'Grundriss der Verg. Anat.,' pp. 134 and 325, 1879.

regard the group Mollusca as a single series, with the Polyzoa at the bottom and the higher forms at the top, nor does he accept the division of the group into Mollusca and Molluscoidea, but divides it into two *branches*, the Eucephala and the Lipocephala, and in the second branch he places the Polyzoa, Brachiopoda, and Lamellibranchiata.[1]

Finally we have the extreme view of Morse, that "the Brachiopoda are not merely related to the Vermes, but are actually ancient cephalized Chætopod Annelids." Packard in his 'Life Histories,' 1876, gives a still different opinion. He says, p. 149, "It will be seen that neither in the Polyzoa nor Brachiopoda are there any true Molluscan characters, nothing homologous with the foot, the shell-gland, or the odontophore. The Brachiopods should in our opinion, be perhaps united with the Polyzoa and form a group lower but sub-parallel with the Annelids. The Brachiopods, from the facts afforded by Morse and others, have neither such a nervous system of respiratory or circulatory organs, nor annulated body, as would warrant their union with the Chætopods. Morse has fully proved that they are a synthetic type, combining the features of different groups of Worms, and this fact apparently forbids their being regarded as a group of Chætopods. Looking at the subject from an evolutional point of view, we should be inclined to regard the Brachiopods and Polyzoa as derived from common low vermian ancestors, while the Chætopod Worms probably sprang independently from a higher ancestry."

I regret not to have space to reproduce Prof. Brooks' instructive reasoning upon the subject; he says, at p. 93 of his Memoir: "Our account of the organisation of the *Lingula* larva shows that it is not only like a Polyzoon, but that it is actually one;" and at p. 102 he adds: "The Brachiopoda then are 'Vermes' in the same sense that the Echinoderms, Molluscs, Tunicates, and Vertebrates are, and in order to include them we must make the word almost synonymous with 'Cœlomatous Metazoa.' In the case of the Brachiopoda and Polyzoa, on the other hand, we have a resemblance which is definite and minute, which is most marked during the youngest stages of development and gradually becomes less conspicuous as the adult characteristics are acquired; and there appears to be every reason to conclude that the relation of the Brachiopoda to other Invertebrates must be traced only through the Polyzoa." In conclusion, he says, p. 106, "The Rotifera, Polyzoa, and Veliger, seem to be three branches which diverged, very early, from a common Vermian stem. The Brachiopoda are the most highly specialised representatives of the Polyzoön branch, and the true Mollusca stand in a similar relation to the Veliger branch. The three stems appear to be sufficiently closely related to each other, and sufficiently sharply distinguished from all other animals to constitute by themselves one of the fundamental divisions of the Animal Kingdom, which might be called, on account of the conspicuous character of the trochal disk, the *Trochifera*." In conclusion, he adds, "I may be allowed to call attention to the obvious fact that the persistence of *Lingula*, entirely without change, for a period which is too great to be measured in the terms of

[1] "Note on Embryology and Classification," 'Quart. Journ. of Microscopical Soc.,' vol. xvii (New Series), p. 448, October, 1877.

such a unit as the length of human experience, is a very forcible instance to show that the facts of zoology absolutely forbid the acceptance of any theory of necessary evolution by continuous progress from homogeneity to heterogeneity."

Dr. J. F. Van Bemmelen says, in his excellent memoir on the 'Anatomy of the Brachiopoda' already referred to, that the results of his own investigations would lead him "to confirm to some extent the opinion of the Hertwigs as to the Brachiopods being typical enterocœlic animals." "The Brachiopoda," he adds, "are closely allied to the Chætognathi. The great external differences between these animals are all attributed by him to the influence of the shells, and so considered secondary changes; while, on the contrary, the features common to both are called by him chief or primary characters of organisation. As such he mentions the similarity in development, already pointed out by Butschli and the Hertwigs—the segmentation of the larvæ into three portions—the number, position, and origin of the generative organs, and their relations to the nephridial efferent ducts—the perfectly similar structure of the nerve-collar with its two centra—the ventral and dorsal longitudinal and the two pairs of transverse mesenteries. To these facts he adds some remarks on the great similarity in histological structure between the Brachiopods and Chætognathes, such as the great simplicity of all the epithelial layers, the subordinate significance of the connective tissue, the similar character of the muscles, the plexiform distribution of peripheral nerves, and the occurrence of horny setæ in ectodermal follicles. The points of difference between Brachiopods and Chætognathes are explained as consequences of the development of the shell, which in itself cannot be an argument against their affinity. This shell caused the development of the peduncle, the arms, and the muscles, the removal of the anus to the right side or its total disappearance, together with eyes, auditory organs (?), and jaws, and perhaps also the unisexuality (to prevent self-fertilisation, while cross fecundation was secured by the animals living in colonies). As support for this view the author points out the great difference in plan and structure of peduncle, arms, and muscular system in different kinds of Brachiopods, especially in Testicardines and Ecardines."[1]

In conclusion, I may perhaps be allowed to say that I have endeavoured briefly, and as far as possible, in the different authors' own words, to fairly lay before the reader the rather conflicting views that have been entertained with respect to this very important and difficult subject.

The most remarkable thing about all this theorising seems to be, not the relations of the Worms and Brachiopods, which doubtless were derived from the same or from allied root-forms, and which (as also in Mollusca, like *Dentalium* and the Pteropods) everybody may see and accept, but the attempt to include the greater in the less. "Everybody," writes Dall in a letter to me, "with a knowledge of systematic natural history, must know the systematic value of the *Brachiopoda, as a group*, to be greater than that of the smaller groups of Worms, in which it is proposed to include them.

[1] 'Annals and Mag. of Nat. Hist.,' vol. xi, 5th series, pp. 383, 384, 1883.

Soft Parts of the Adult Animal.

The progress effected in our knowledge of the soft parts of the animal of the Brachiopod has been very great since the commencement of the present century, and especially since the period when I commenced my labours in connection with the class; and these very important and valuable results have been attained through the patient and persevering labours of but a small number of British and foreign experienced anatomists and zoologists.

In 1766 Pallas gave some account of the animal,[1] and in 1773 Pennant briefly noticed some of the soft parts of *Terebratulina caput-serpentis*, especially those relating to the brachial or labial appendages.[2] In 1774 Gründler published a good description or rather figure of the same appendages.[3] Again, in 1788, Müller,[4] and subsequently Poli,[5] described some parts of the animal of *Crania*, with enlarged illustrations in which the labial appendages are represented. In 1797 Cuvier published a short note on the animal of *Lingula*,[6] with figures; and in the same year Lamanon described some of the soft parts of the animal of *Terebratella*.[7]

This is about all that had been done with respect to the animal of the Brachiopod previous to 1800. It amounts to little, as regular dissections had not been made.

Since 1800 this important subject of investigation has been taken up in a serious manner, and the animal of the following recent species has been more or less thoroughly examined anatomically and illustrated:—*Terebratulina caput-serpentis* and *T. septentrionalis*; *Terebratula vitrea*; *Waldheimia flavescens*, *W. cranium*, *W. septigera*; *Terebratella dorsata*; *Argiope* (*Cistella*) *neapolitana*; *Thecidium mediterraneum*; *Rhynchonella psittacea*, *Lingula anatina*, *L. affinis*, *L.* (*Glottidia*) *pyramidata*; *Discina lamellosa*; *Crania anomala*.[8] Some parts of the animal have also been examined of *Terebratulina cancellata*; *Terebratula Moseleyi*; *Waldheimia Kerguelenensis*; *Megerlea truncata*; *Platidia anomioides*, *Argiope decollata*. There are, however, some points or details in connection with the anatomy of the animal of the Brachiopoda that have still to be determined, and the work is continually progressing through the efforts of several of our ablest investigators.

[1] 'Miscellania Zoologica,' 1766. Prof. Owen in 1833 says that Pallas noticed the limited situation of the viscera in *Terebratula*. He described the arms with his usual minuteness and accuracy, considered them as branchiæ, and compared them to those of a fish; he enumerated three pairs of muscles, and noticed the situation of the mouth and stomach, but not that of the anus.

[2] "*Anomia*," 'Nova Acta Regiæ Societatis Upsaliensis,' vol. i, p. 38, de 1773.

[3] "On the Animal of *Ter. caput-serpentis*," 'Die Naturforscher,' vol. i, 1774.

[4] "Zoologica Danica," 'Seu Animalium Daniæ et Norvegiæ &c.,' vol. i, 1778.

[5] "Testacea utriusque Siciliæ," 1795.

[6] "Mémoire sur l'Animal des Lingules," 'Bull. de la Soc. philomatique de Paris,' vol. i, p. 3, pl. vii, 1797.

[7] "Sur les Terebratules ou Poulettes," 'Voyage de la Perouse autour du monde,' 1797. Notwithstanding every research I have made in Paris and elsewhere it has been impossible to find the specimen described by Lamanon by the name of "Petite poulette" figured in that work.

[8] George Sowerby in his paper on "*Orbicula* and *Crania*" ('Transactions of the Linnean Society of London,' vol. xiii, pl. xxvi, 1818) gives figures of some of the soft parts of the animal of *Crania anomala*.

Of the animals of the extinct genera and species we can never know or learn more than what may be seen on the interior surface of their valves; still for all that, the characters of some soft parts of their animal, such as of the mantle, the vascular and ovarian spaces, muscles, and labial appendages may be traced and interpreted with every degree of confidence; and my continual efforts, during the progress of this Work, have been to decipher, describe, and illustrate all those details observable in the fossil genera and species.

It would not be possible in this brief summary to do more than to refer to some of the principal and more important results that have been attained, for to enter into full anatomical details would demand long descriptions and elaborate illustrations which would exceed the limits prescribed by the Palæontographical Society. The reader is therefore referred for more ample details to the works of Cuvier,[1] R. Owen,[2] Quenstedt,[3] Vogt,[4] Huxley,[5] Gratiolet,[6] O. Schmidt,[7] Hancock,[8] Davidson,[9] Woodward,[10] J. Steenstrup,[11] Semper,[12] MacCrady,[13] Hyatt,[14] MacDonald,[15] E. Deslongchamps,[16] Lacaze-

[1] "Mémoire sur l'animal de la Lingule," 'Mémoires du Muséum,' vol. i, p. 69, pl. vi, 1802.

[2] "On the Anatomy of the Brachiopoda, and more especially of the Genera *Terebratula* and *Orbicula*." 'Phil. Trans. of the Royal Society,' communicated November, 1833; "On the Anatomy of the Terebratula," 'Davidson's Monograph,' Chapter I; 'British Fossil Brachiopoda,' 1853; "Lettre sur l'appareil circulatoire chez les mollusques de la classe des Brachiopodes," 'Ann. des Sciences naturelles,' Paris, 3rd ser., 1853.

[3] "Ueber das Oeffnen und Schliessen der Brachiopoden," Wiegmann's 'Archiv,' vol. ii, pp. 220—222, 1835.

[4] "Anatomie der *Lingula anatina*," 'Nouv. Mém. de la Soc. Helvetique des Sciences' vol. vii, 1845.

[5] "Contributions to the Anatomy of the Brachiopoda," 'Proc. Royal Soc.,' vol. xiv, 2nd ser., p. 285, 1854.

[6] "Recherches sur l'anatomie de la Terebratule australe, pour servir a l'histoire des Brachiopodes," 'Comptes Rendus,' p. 45, 1853; "Études anatomiques sur la Terebratule australe," 'Journ. de Conch.,' October, 1857, p. 209; "Études anatomiques sur la Lingule anatina," 'Journ. de Conch.,' p. 49, 1860.

[7] "Die neuesten Untersuchungen über die Brachiopoden," von Owen, Carpenter, und Davidson, mit einigen Zusatzen; Zeitschrift, 1854.

[8] "On the Organisation of the Brachiopoda," 'Proc. Roy. Soc.,' vol. viii, 1847; "On the Organisation of the Brachiopoda," 'Phil. Trans.,' vol. 148, 1858.

[9] Introduction to vol. i of 'British Fossil Brachiopoda,' Pal. Soc., 1853.

[10] 'A Manual of the Mollusca,' p. 209, 1854.

[11] "Om Anomias stilling tel Meislingerne og Terebratulern," 'Skandinavian Naturf. Förhandl.,' v, 61, 958, 1847, and 'Proc. of the Royal Danish Academy,' 1847.

[12] "On Lingula," 'Zeitschrift für Wissenschaftliche Zool.,' vol. ii, p. 100, 1859, and vol. xiv, 1864.

[13] Letter to Mr. W. Stimpson on *Lingula pyramidata*, 'Siliman's Am. Journ. of Science and Arts,' vol. xxx, 2nd ser., 1860; "Notice on a Larval Brachiopod," 'Proc. of Elliot Soc. of Nat. Hist. of Charleston, S. C.,' 1860.

[14] "Obs. on Polyzoa," 'Proc. of the Essex Institute,' Massachussets, vols. iv, v.

[15] "On the Physiology of the Pallial Sinuses of the Brachiopoda," 'Trans. of Linn. Soc.,' vol. xxiii, 1861.

[16] "Sur la fonction des spicules renfermés dans le Manteau de certaines Brachiopodes," December 1860, No. 1408, de 'l'Institut, Journal universel des sciences et des sociétés savantes en France et à

Duthiers,[1] Morse,[2] King,[3] Kowalewsky,[4] Hérouard,[5] W. K. Brooks,[6] Van Bemmelen.[7]

Mantle, Vessels, Ovaries, &c.—Both valves are, in all Brachiopoda, lined by a delicate bilobed membrane, termed the "pallium" or mantle; it secretes the shell, and is generally, although not always, fringed with horny bristles or setæ. These setæ are quite straight and brittle, often thickly and deeply implanted between the laminæ of the mantle; they serve to guard the opening of the valves. In some species they are short; but they vary much in length, and are sometimes barbed throughout with delicate hook-like spines (as in *Discina lævis* or *lamellosa*). In some cases they bifurcate near their extremities, but lie close together at their origin. In *Discina atlantica*, dredged by the "Challenger" expedition, and of which I have some admirable preparations, the setæ are as long as, and even longer than the diameter of the shell.[8]

The mantle is composed of an outer and an inner layer, between which are situated the blood-channels or lacunes. The mantle has been ably described by Hancock, E. Deslongchamps, and others. Deslongchamps observes "that all the internal parts of the

l'Étranger; 'Recherches sur l'organisation du Manteau chez les Brachiopodes articulés et principalement sur les spicules calcaires contenus dans son intérieur,' 4to., Caen, 1864.

[1] "Histoire Naturelle des Brachiopodes vivants de la Mediterranée," 'Ann. des Sciences Nat.' 4th Ser. Zool., vol. xv, p. 259, 1861.

[2] "The Hæmal and Neural Regions of Brachiopoda," 'Proceedings of Boston Soc. of Nat. Hist.,' vol. ix, 1862.

"A Classification of Mollusca based on the Principle of Cephalization," 'Proc. of Essex Institute, Salem,' vol. vi, 1865.

"On the Early Stages of Brachiopoda," 'American Nat., Salem,' vol. iii, 1869.

"Position of the Brachiopoda in the Animal Kingdom," 'American Nat.,' vol. iii, 1870.

"The Brachiopoda, a Division of Annelida," 'Am. Journ. of Science and Arts,' vol. l, 1870.

"A Reply to Mr. Dall's Criticism on the Brachiopoda, a Division of Annelida," 'Am. Journ. of Science and Arts,' vol. l, 1870.

"On the Early Stages of Terebratulina," 'Mem. Boston Soc. Nat. Hist.,' 1871.

"On the Oviducts and Embryology of Terebratulina," 'Amer. Journ. Science and Arts,' vol. iv, 1872.

"On the Systematic Position of Brachiopoda," 'Proc. Boston Soc. Nat. Hist.,' vol. xv, 1873.

"Embryology of Terebratulina," 'Memoirs Boston Soc. of Nat. History,' vol. ii, 1874.

"Notes on Japanese Lingula," 'Am. Journ. Sci. and Arts,' series iii, vol. xv, p. 156.

"Notes on Rhynchonella," 'Am. Journ. Sci. and Arts,' series iii, vol. xvii, p. 257.

[3] "On some Characters of *Lingula anatina*," 'Ann. and Mag. of Nat. Hist.,' 4th ser., vol. xii, 1873.

[4] "Observations on the Development of the Brachiopoda," Moscow, 1873, also summary by Oehlert and Deniker, 'Arch. de Zool. Exp. et Gen.,' 2nd ser., vol. i, 1883.

[5] "Sur les courants de Nutrition des Brachiopodes," 'Journal Conchyliologique,' 1877.

[6] 'The Development of Lingula and the Systematic Position of the Brachiopoda,' "Chesapeake Zoological Laboratory, Scientific Results for the Session of 1878."

[7] 'Over den Bouw der Schelpen van Brachiopoden en Chitonen; Leiden,' 1882; "Untersuchungen über den anatomischen und histologischen Bau der Brachiopoda Testicardinia," 'Zeitschrift f. Naturwissenschaft,' xvi, N. F. 1, 2, 1883.

[8] Davidson, "Reports of the 'Challenger' Expedition," 'Zoology, Brachiopoda,' vol. i, p. 64, pl. iv, fig. 17 *a* and *b*, 1880.

shell are lined by the internal layer of the mantle, with the exception of the muscular impressions, or those portions where the muscles are inserted on the interior surface of the shell."[1] The outer layer closely lines the inner surface of the valves, to which it sometimes adheres; and in those species in which the shell is traversed by canals, there exists on the surface of the mantle facing the inner surface of the valves corresponding short, cylindrical, membranaceous projections or cæca, inserted into the tubular orifices traversing the shell. These cæcal prolongations do not exist in those genera (such as *Rhynchonella*) where the shell has no tubular perforations. The inner layer is rather thicker than the outer one, and is covered with vibratile cilia. Between the two layers composing the mantle are, as we have already said, the blood-channels or lacunæ. These vary in their disposition in different genera; as they project to some small extent, they leave corresponding indentations or depressions on the inner surface of the shell, so that their shape and directions can very often be traced on the fossils of extinct genera and species, as well as if the animal were still living. A knowledge of the characters and variations assumed by the vascular system in the Brachiopoda is therefore of great importance, especially in the study of extinct forms.

In some groups there are four principal arterial trunks in the dorsal lobe of the mantle; and these in most cases run direct to the front (at any rate, the central pair), and bifurcate at intervals. The other two or outer vessels, in some genera, deviate at about half their length and curve round towards the cardinal edges, encircling the ovarian spaces and giving off numerous branches, which bifurcate several times from their outer margin and extend all round the margin of the mantle. According to Cuvier, the first indication of a special breathing organ is presented in *Lingula*, in which the veins develope parallel rows of small vascular processes. The veins, as stated by S. P. Woodward and others, open into the visceral cavity, which is in itself a great vascular sinus.

Examples of these different arrangements of the vascular system will be seen in the pages and plates of this Monograph, as well as in the works of other palæontologists. I have lost no opportunity of representing them where they came under my notice. They are very often observable on the well preserved surface of internal casts, which in reality represent the surface of the mantle itself. For this reason well preserved internal casts should always be sought for and carefully examined.

Hancock observes, and the same has been noticed by several other zoologists, that the inner lamina of the mantle, and more particularly that portion of it forming the floor of the great pallial sinuses, undoubtedly assists in the purifying of the blood. The mantle-lobes are therefore not only organs by which the shell is formed and repaired, but are subservient to the process of respiration and circulation of the blood, and sometimes to the ejection of the eggs which accumulate in the larger sinuses of the arterial system.

The Brachiopoda are extremely prolific, and their innumerable ova are spherical or

[1] 'Recherches sur l'organisation du Manteau chez les Brachiopodes articulés,' Caen, 1864.

kidney-shaped. They are supposed by Hancock to escape by two orifices situated at the sides of the mouth. Recent *Discinæ* often seem to have minute fry attached to their valves; and Prof. Suess, of Vienna, has noticed a specimen of the fossil *Stringocephalus* which contained numerous embryo shells.

As already stated, it is very often possible to trace the position of the ovarian spaces on the interior surface of the valves of many fossil specimens of Brachiopoda, and especially so in *Orthis*, *Strophomena*, and *Productus*; and of these I have given good illustrations.

Before concluding this very brief account of the mantle of the Brachiopoda, it must be remarked that in 1854, in his review of my Monograph 'On British Fossil Brachiopoda,' Oscar Schmidt called attention to an important anatomical omission, namely, the existence of a vast number of microscopic, flattened, calcareous, denticulated plates or spicula on certain parts of the surface of the mantle, which served no doubt to stiffen portions that contained them.[1]

It was moreover remarked, by Hancock and E. Deslongchamps,[2] that these calcareous plates "are not spread over the entire surface of the mantle, but only over the large vascular sinuses, the arms, and perivisceral cavity." These spicula do not, however, appear to be present in every species, being totally absent in *Lingula*, *Rhynchonella*, and some other genera; but Deslongchamps again observes "After examination of the genera *Terebratula*, *Terebratulina*, *Megerlea*, *Kraussina*, and *Platidia*, we find a series in which the number and consistency of the calcareous portions increase in a very rapid manner, the spicula forming several layers, leading the observer by a series of gradations to the genus *Thecidium*, in which the spicula are soldered together, occupying the whole of the mantle, and incrusting it to such an extent that the mantle is no longer distinguished from the shell itself. The mantle forms that calcareous mass which equals in consistency the brachial appendages, a fact of which Palæontologists have often and in vain sought the explanation."

Muscles.—In the General Introduction to Vol. I of this Monograph, Sir Richard Owen described the muscles of the Brachiopod; and in my portion of the same Introduction I reproduced some of Hancock's and my own views upon the subject. Since then

[1] In vol. xvi, 2nd series, of the 'Annals and Mag. of Natural History' for December, 1855, I gave a translation of the following passage from Prof. Schmidt's paper:—"The mantle, oral arms, and cirri in *Terebratulina caput-serpentis* contain an innumerable number of calcareous plates, generally flattened, dilated, and irregularly denticulated, situated in close vicinity to each other. It is easily conceived that these calcareous masses stiffen the parts which contain them, and seem particularly to serve this function in the hollow cirri, thus preventing their sides from sinking down. In the Norwegian *Terebratulæ* I have examined they are not to be found, nor have I obtained them in *Terebratula dorsata*; but further investigations conducted on a large number of species will show whether they are or are not peculiar to *Terebratula caput-serpentis*."

[2] 'Sur la Fonction des Spicules renfermés dans le Manteau de certaines Brachiopodes,' 1860, and 'Recherches sur l'Organisation du Manteau chez les Brachiopodes articulés,' 4to., Caen, 1864

additional researches have been made by several zoologists, and, I believe, we are at present fairly well acquainted with the characters and functions of this important part of the animal.

As the number and position of the muscles differ materially in the two great divisions *Clistenterata* and *Tretenterata* into which the Brachiopoda have been grouped, and to some extent also in the genera of which each division is composed, it may be desirable to treat the subject under two separate heads. Unfortunately, almost every anatomist who has written on the muscles of the Brachiopoda has proposed different names for each muscle, and the confusion thence arising is much to be regretted. In the *Clistenterata*, of which the genus *Terebratula* may be taken as an example, five or six pairs of muscles are stated by Hancock, Gratiolet, and others to be connected with the opening and closing of the valves, or to their attachment to, or movements upon, the peduncle.

Fig. A.

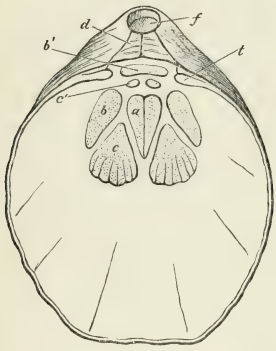
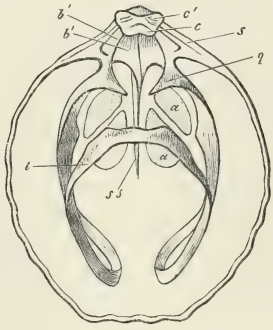


Fig. B.



Waldheimia flavescens.

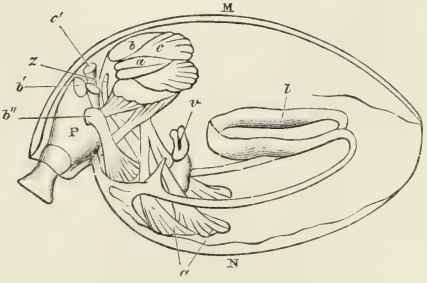
Fig. A. Interior of the ventral valve. *f*, foramen; *d*, deltidium; *t*, teeth; *a*, adductor impressions (=occlusors of Hancock); *c*, divaricators (=cardinal muscles of King=muscles diducteurs principaux of Gratiolet); *c'*, accessory divaricators (=muscles diducteurs of Gratiolet); *b*, ventral adjustors (=ventral peduncular muscles, or muscles du pedoncule, paire supérieure, Gratiolet); *b'*, peduncular muscle.

Fig. B. Interior of dorsal valve. *c*, *c'*, cardinal process; *b*, *b'*, hinge-plate; *s*, dental sockets; *l*, loop; *q*, crura; *a*, *a*, adductor impressions; *c*, accessory divaricator; *b*, peduncular muscles; *s*, *s*, septum.

First of all, the adductors or occlusors consist of two muscles, which, bifurcating near the centre of the cavity, produce a large quadrangular impression on the internal surface of the dorsal valve (Fig. B *a*, *a*), and a single divided one towards the centre of the large or ventral valve (Fig. A *a*). The function of this pair of muscles is the closing of the valves. Gratiolet, who has described with great minuteness the muscles of the Brachiopoda, informs us that those which close and open the valves were the only ones known to Pallas, and he defined their position and functions clearly.[1] The same was

[1] 'Miscellanea Zoologica,' 1766.

done by Blainville[1] and Quenstedt,[2] but the absence of good figures caused much uncertainty to prevail. This deficiency was subsequently supplied by Owen's, Hancock's, and Gratiolet's admirable descriptions and illustrations. The two other pairs have been termed *divaricators* by Hancock, or cardinal muscles (muscles diducteurs of Gratiolet); and have for function the opening of the valves. The divaricators proper are stated by Hancock to arise from the ventral valve, one on each side, a little in advance of, and close to the adductors, and, after rapidly diminishing in size, to become attached to the cardinal process, a space or prominence between the sockets in the dorsal valve. The *accessory divaricators* are, according to the same authority, a pair of small muscles which have their ends attached to the ventral valve, one on each side of the median line, a little behind the united basis of the adductors, and again to the extreme point of the cardinal process. Two pairs of muscles, apparently connected with the peduncle and its limited movements, have been minutely described by Hancock as having one of their extremities attached to this organ. The *dorsal adjustors* are attached to the ventral surface of the peduncle, and are again inserted into the hinge-plate in the smaller valve. The *ventral adjustors* are considered to pass from the inner extremity of the peduncle, and to become attached by one pair of their extremities to the ventral valve, one on each side of, and a little behind the expanded base of the divaricators. The function of these muscles is not only that of erecting the shell, but also that of attaching the peduncle to the shell, and thus steadying the latter on the peduncle. Gratiolet describes the peduncle with great care and states that it is composed of two portions. First of a horny sheath formed of concentric epidermic layers, very analogous to that which Vogt has described in *Lingula*. Second, a fibrous stem enveloped by the sheath. This stem, composed of tendinous fibres, is fixed by its free extremities to rocks, shells, corals, and other marine objects; the other end passes through the foramen and ends in a bulbous-shaped extremity.



Waldheimia flavescens (after Hancock).

M, Ventral valve; N, dorsal valve; *l*, loop; *v*, mouth; *z*, extremity of intestine; *a*, adductor; *c*, divaricators; *c'*, accessory divaricators; *b*, ventral adjustors; *b'*, peduncular muscle; *b''*, dorsal adjustors; P, peduncle.

Hancock describes the peduncle as composed of a dense, muscular, semi-cartilaginous

[1] Article "Terebratula," in the 'Dictionnaire des Sc. Naturelles,' tom. 53, p. 132, 1824.

[2] "Ueber das Oeffnen und Schliessen der Brachiopoden," Wiegmann's 'Arch.,' vol. ii, pp. 220, 222, pl. iv, figs. 4, 5, 6, 1835; see also Davidson, 'Annals and Mag. of Nat. Hist.,' December, 1855, where a translation of Quenstedt's paper is given.

mass, of a cylindrical form, with one extremity erected through the foramen of the ventral valve, and the other resting within its umbonal region; the protruded extremity is protected by a thick horn-like covering of brownish colour.

Dr. Van Bemmelen says that "the so-termed tendinous portions of the muscles were found to be specially developed portions of the mesenchymatic layer under the real insertions of the muscular fibres. This was most obviously shown in the occlusor muscles of *Waldheimia*, where the tendons are united, to a considerable extent, with the body-wall, and where in transverse sections, not the slightest difference or limit between them is to be found. The same origin must be attributed to the peduncle, which, contrary to that of *Lingula*, consists of a solid mass of mesenchymatic tissue containing many fibres; such fibres are also found on the margin of the mantle and the free or inner walls of its tissues. They serve for support, and were believed to be muscular by Hancock."

The peduncle varies in length in different species; in some forms it is so exceedingly short that the beak becomes worn from its restricted movements in close contiguity to the rock to which it is attached; while in some species, such as some *Linguleæ*, it often attains and sometimes exceeds half a foot in length. It is sometimes found preserved in the fossil condition, as I have shown to be the case in a specimen of *Lingula Lesneuri* discovered by Mr. Vicary, as well as in an example of *Eichwaldia* (*E. subtrigonalis*, Billings). Figures of these will be found in the pages of my 'Silurian Monograph' and of its Supplement.

Dr. Van Bemmelen states ('An. Nat. Hist.,' 5th series, vol. xi, p. 382) that he found the structure of the muscles to agree with the description Hancock had given of them. "They consist of thin longitudinal fibres, perfectly parallel, and probably as long as the whole muscle itself. Opposed externally to these fibres are found nuclei surrounded by a very minute quantity of protoplasm. From this fact, he deduces the epithelial character of the muscles, which probably have originated from the cœlomic epithelium, and, in becoming independent of it, have retained the nuclei of their formative cells. All the muscular fibres were found to be smooth, with the exception of those of the posterior occlusors, which are distinctly striated. In this fact, already mentioned by Hancock, there is seen a new proof for the assertion of the Hertwigs, that between smooth and striated muscles there need not be any morphological, but only a physiological difference. The occlusores, posteriores and anteriores have the same function; they are inserted on the same tendinous mass; but the former are striated, the latter smooth."

Such is the general arrangement of the shell-muscles in the division composing the Articulated Brachiopoda, making allowance for certain unimportant modifications observable in the shells composing the different families thereof. Owing to the strong and tight interlocking of the valves by the means of curved teeth and sockets most of the Brachiopoda could open their valves but very slightly. In some species, however, such as *Thecidium*, as Lacaze-Duthiers informs us, the animal could raise its dorsal valve at right

angles to the plane of the ventral valve and close it instantaneously like in the lid of a snuff-box.

In his valuable memoir,[1] this distinguished French zoologist gives the most complete description of the animal of *Thecidium* we now possess; he says "that there are three pairs of muscles possessing distinct directions and functions, six muscles in all. Of these six muscles two are lateral, short, wide, and easily observable, and serve, without doubt, for the occlusion of the shell." (These are Duthiers' "muscles adducteurs lateraux ou externes.") Hancock informed me by letter that these would represent his "adjustors," but that the function of this pair of muscles does not appear to be exactly similar to the "adjustors" of *Waldheimia*, in which they move the shell upon the peduncle; for in *Thecidium* they assist both in closing the valves and in preventing any irregular or lateral movements, which, from the central position of the occlusors, might be liable to take place. In fact, he believed that the functions of the "adjustors" in *Thecidium* is modified, much as it is in the same muscles of *Lingula*, and he was therefore inclined to conjecture that the two valves of the former are not so firmly hinged as they are in other articulated forms. "The second pair are those nearest to the median line." These are termed the "muscles adducteurs internes" by Professor Lacaze-Duthiers, and are equivalent to Hancock's "anterior and posterior occlusors." In the ventral valve these muscles are fixed to the bottom of the valve nearly under the extremity of the tongue-shaped "ascending shelly process," and then attached to the two thin shelly processes which we have described as existing in the cavity of the beak. The functions of these muscles (as stated by Duthiers) is also to effect a closing of the valves, but less efficaciously than the preceding pair. The third pair, which M. Duthiers designates "muscles adducteurs," are Hancock's "divaricators," and their function is to open the valves. They form four large impressions on the bottom of the ventral valve, on either side of the central septum, and have their other end attached to the extremity of the cardinal process of the dorsal valve.

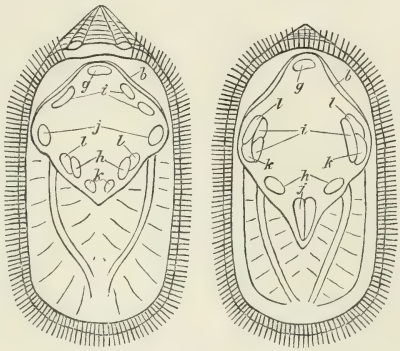
Although the characters relating to the disposition of the muscles and their functions in the *Tretenterata* and *Clistenterata* are now fairly ascertained, it would be very desirable that they should be described and figured in those recent genera that have not been yet anatomically examined. Their characters are of very great importance to the palæontologist in his study of the extinct genera and species, and I have devoted much time and attention to the subject during my many researches in connection with both recent and fossil forms.

In the *Tretenterata*, of which *Lingula* and *Discina* may be quoted as examples, the myology is much more complicated, and anatomists have differed considerably in their respective views concerning the functions of some of the muscles. They have been care-

[1] "Histoire naturelle des Brachiopodes vivants de la Mediterranée," 'Annales des Sciences Naturelles," 4th ser., vol. xv, p. 258, 1861.

fully studied and illustrated by Owen, Vogt, Hancock, Gratiolet, Semper,[1] Woodward, Morse, Brooks, and others; and more recently by King,[2] whose views seem to carry with them a greater degree of probability; and these opinions have been confirmed by Brooks in his admirable memoir on *Lingula*.[3] Of the muscles of the shell (valves) he makes out five pairs and an odd one, and individualises their respective functions as follows:—Three pairs are lateral, having their members limited to the sides of the shell; one pair is transmedian, each member passing across the middle of the reverse side of the shell, while the odd muscle occupies the umbonal cavity. The central or *umbonal* muscles effect the direct opening and closing of the shell; the *laterals* enable the valves to move forwards and backwards on each other. The *transmedians* allow the similar extremities (the rostral) of the valves to turn from each other to the right or the left on an axis subcentrically situated, that is, the medio-transverse region of the dorsal valve. It was long a matter in discussion whether the animal could displace its valves sideways when about to open its shell, but this has been actually observed by Professors Semper, Morse, and Brooks, who saw the animal perform the operation. They mention that it is never opened suddenly or by jerks, as the valves are first always pushed to one side several times and back again on each other, at the same time opening gradually in the transverse direction till they rest opposite to one another and widely apart. Those who have not seen the animal in life, or did not believe in the possibility of the valves crossing each other with a slight obliquity, would not consent to appropriating any of its muscles to that purpose, and consequently attributed to all the lateral muscles the simple function of keeping the valves in an opposite position, or holding them adjusted.

FIG. A. FIG. B.



Lingula anatina (after King).

FIG. A. Interior of the ventral valve.

FIG. B. Interior of the dorsal valve *g*, umbonal muscular impressions (open valves); *h*, central muscles (close valves); *i*, transmedial or sliding muscles; *b*, parietal band; *j*, *k*, *l*, lateral muscles (*j*, anteriors; *k*, middles; *l*, outsiders), enabling the valves to move forward and backward on each other.

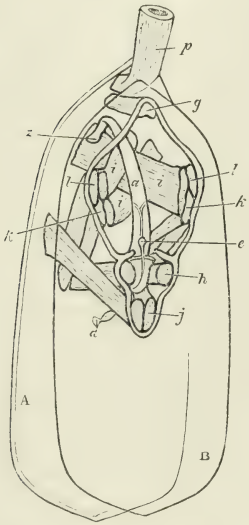
We have not only the observations of Semper and Morse, but the anatomical investigations of King to confirm the sliding action or lateral divarication of the valves of *Lingula*. In the *Clistenterata*, where no such sliding action of the valves is necessary or possible,

[1] 'Zeitschrift für wissenschaftliche Zool.,' vol. ii, p. 100, 1859, and vol. xiv, p. 424, 1864.

[2] "On some Characters of *Lingula anatina*," 'Ann. and Mag. of Nat. History,' 4th ser., vol. xii, 1873.

[3] "The Development of Lingula, &c.," 'Chesapeake Zool. Laboratory, Scientific Results,' p. 35, 1879.

no muscles for such an object are required, consequently none arise from the lateral portions of the valves, as in *Lingula*. But in an extinct group, the *Trimerellidæ*, which seem to be somewhat intermediate in character between the *Tretenterata* and *Clistenterata*, have been found certain scars which appear to have been produced by rudimentary lateral muscles; still it is doubtful (considering the shells are furnished with teeth, though rudely developed) whether such muscles enabled the valves to move forward and backward upon each other, as in *Lingula*.[1] We do not yet possess any reliable observations as to the manner in which *Discina* opens its valves; but Barrett, who observed *Crania* in life, informs us that the valves open by moving upon the straight hinge without sliding the valve. There are muscles connected with other portions of the animal in both groups, such as the *parietal* muscles, strongly defined in the Tretenterates, and distinctive peculiarities of the peduncle, but the limited space at our disposal will not admit of our entering upon further anatomical details.[2]



Lingula anatina. Diagram showing the muscular system, after Hancock. The letters indicate the muscles, as in figures A and B, p. 327.

A, Ventral valve; B, dorsal valve; *p*, peduncle; *e*, heart (?); *a*, alimentary tube; *z*, anal aperture.

We are also indebted to Professor Morse and to Professor W. K. Brooks[3] for some valuable observations on the muscular arrangement in the young ages of *Lingula* (*Glottidia*) *pyramidata*, Stimpson, which animal the former met with in great abundance at Fort Wool in the north of Hampton Roads, Baltimore. Brooks says in his memoir, p. 56: "In the youngest stage observed, only a single pair of muscles are present. They are situated on each side of the œsophagus, close to its union with the stomach, and traverse the body-cavity from one valve to the other. They are the muscles '*h*' of Davidson's article "Brachiopoda" (in the 'Encyclopædia Britannica,' ninth edition; and of King's figures, A and B, here appended); by their contraction they bring the two valves together, compressing the body between them. The separation of the valves appears to be accomplished at this stage entirely by the muscular integument. When the muscles '*h*' are relaxed, and the lateral walls of the body contracted, the width of the body is diminished and its thickness increased, and the valves thus pushed apart. . . . . At a somewhat later stage the

[1] See a paper by Davidson and King on the "*Trimerellidæ*," 'Quart. Journal Geol. Soc.,' vol. xxx, 1874.

[2] The details above given on the muscles were published by myself in the article "*Brachiopoda*," 'British Encyclopædia,' 9th edition, p. 192, 1876.

[3] "The Development of the Brachiopoda," 'Chesapeake Zoological Laboratory,' 1878.

integument at the posterior end of the body is much thickened, and soon a band of muscular fibres, '*r*,' makes its appearance in it upon the median line, and runs directly from one valve to the other. At subsequent stages the fibres increase in number, and form a well-marked muscular bundle, which is the muscle '*g*.' When contracted at the same time with the muscles '*h*,' this muscle serves to flatten the body still more, and this brings the two valves closer together; but when the muscles '*h*' are relaxed and the muscle '*g*' alone contracted, the posterior margins of the valves are brought together and their anterior edges thrown apart, the body furnishing the fulcrum around which they turn." Some time after, "Three pairs of muscles make their appearance in the body-cavity at the sides of the stomach, two on the dorsal and one on the ventral side. . . . In a dorsal view of the same larva the dorsal ends of the two pairs of muscles are seen. They are attached to the shell a little outside the limits of the body, and the integument bends out with them. One pair of them runs forward and downwards, and apparently unites with the ventral ends of the muscle '*h*,' for no corresponding independent muscles can be seen in a ventral view. In the ventral end, '*p*,' the muscle '*h*' is plainly seen to be divided into two by a longitudinal line, and a comparison with the 'Encyclopædia' figures will show that the outer half is the ventral end of the muscle '*u*' of Brooks's figure. This muscle apparently corresponds to the two muscles '*k*' and '*l*' of the adult, and it probably divides into two at a later stage. It would appear, then, from these observations that the muscles '*j*,' '*k*,' and '*l*' of the adult *Lingula* are derived from the muscle '*h*,' some of its fibres separating from it at the ventral end to form the muscles '*j*,' but remaining for some time united to it dorsally; while another bundle separates from the dorsal end, but remains attached for some time ventrally, and gives rise to the muscles '*k*' and '*l*.'

"According to King and Davidson these three pairs of muscles are adapted to move the valves forward and backwards upon each other; but as my observations show that neither the larva nor the adult does slide its valves backwards and forwards to any marked degree, it seems more probable that they, together with the pair of muscles next to be described, cause the rotation of one valve upon the other around the body as a centre. In the dorsal view given by Brooks a pair of muscles, '*u*,' are shown attached to the shell close to the muscles last described, and running backwards and inwards under the stomach. These are the muscles '*i*,' which in the adult cross each other under the digestive organs, and are the principal causes of the rotation of one valve upon another, which has been described by Semper[1] and Morse."

Lingula pyramidata, from life (after Morse).

Professor Morse says that he observed that *Lingula* had the power of moving over the

[1] 'Zeitschrift für wissens. Zool.,' vol. 2, 1859.

sand by the sliding motion of the two valves, using at the same time the fringes of setæ, which swung promptly back and forward, like a bank of oars, leaving a peculiar track in the sand. In the motion of the setæ he noticed the impulse commencing from behind and running forward.[1]

Muscular scars are beautifully displayed on the interior surface of the valves of many fossil forms, and they can be understood now that their functions have been determined from their study in the recent species. They vary, however, a great deal in shape and position in some genera.

It was some time before Prof. King and myself could interpret the characters of the scars, and the assumable functions of their muscles, on the inner surface of the valves in the *Trimerellidæ*. After much research we arrived at the conclusion that this group was most nearly allied, though differing in many respects, to that division of the Brachiopoda of which *Lingula* may be considered as the type. The differences between the two groups, we contended, were quite sufficient to warrant the step we took in making of each a distinct family ; while on the other hand, the points of agreement are so numerous as to show that they are intimately related. *Obolus* is placed by Dall in the family *Lingulidæ;* but its close relationship to *Discina* opposes the allocation; this alone prevents our placing the Trimerellids in any family group which embraces the *Obolus*, though we are quite ready to admit that both belong to one and the same great division in their class.

The muscles in *Crania* and the impressions they left in the interior of the valves have been described and illustrated in page 192 of my 'Monograph of Carboniferous Brachiopoda,' Vol. II. Those of *Discina* were described by Sir R. Owen in his memoir on the "Anatomy of the Brachiopoda" in the 'Transactions of the Zoological Society,' vol. 1, p. 153, November, 1833, and at page 127 of my General Introduction in Vol. I of this Monograph. We do not yet, however, possess satisfactory anatomies of the two genera above alluded to.

The brachial appendages (Vol. V, Pl. XXI, figs. 1, 3, 4) are a pair of very remarkable and beautiful organs eminently characteristic of the Brachiopoda. They are often, and more correctly, termed *labial* appendages on account of each member being a prolongation of the lateral portions of the lips or margin of the mouth. Spirally fringed labial appendages were first noticed by Pallas in *Terebratula* and by Otto F. Müller in *Crania*.

The labial appendages assume different shapes in different genera, and are supported or otherwise, by the more or less complicated calcified lamellæ already described. The labial appendages, whether they form a pair of long, bent, or spirally convoluted organs, occupy the larger portion of the cavity of the shell in front of the visceral chamber; they therefore are mainly composed of a membranous tube fringed on one side with long flexible hollow cirri which were not capable of being protruded in those

[1] "The Brachiopoda, a Division of Annelida," 'American Journal of Science and Arts,' vol. i, 1870.

families and genera in which they were folded back upon themselves and supported by a calcareous skeleton as in *Waldheimia*.

Fig. A.

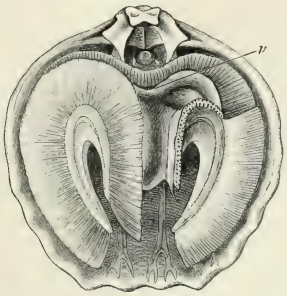
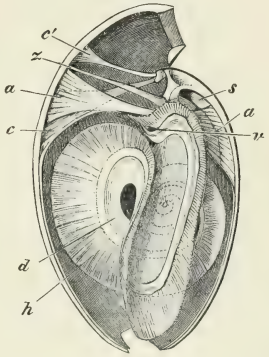


Fig. B.



Waldheimia flavescens.

Fig. A. Interior of dorsal valve to show the position of the labial appendages (a portion of the fringe of the cirri has been removed to show the brachial membrane and a portion of the spiral extremities of the arms). Enlarged.

Fig. B. Longitudinal section, with a portion of the animal. *d*, *h*, brachial appendages; *a*, adductor; *c*, *c'*, divaricator muscles; *s*, septum; *v*, mouth; *z*, extremity of alimentary tube. The peduncular muscles have been purposely omitted. Enlarged.

In *Rhynchonella*, where the elongated spiral appendages are supported only at their origin by two short, curved, projecting calcareous processes, they could be unrolled at the will of the animal and protruded to some distance beyond the margins of the valves. When forcibly stretched out, they are said to be more than four times the length of the shell, and support some 3000 cirri. See Hancock's admirable illustration of the animal of *Rh. psittacea*, reproduced here in Pl. XXI, fig. 3.

In a note on the extension of the coiled arms in Brachiopoda, Professor Morse says: "Years ago von Buch recorded that Otto F. Müller had observed *Rhynchonella psittacea* protrude its arms beyond the anterior borders of the shell. This single observation was not widely accepted, and many doubted the possibility of the arms being exserted in this manner. In the year 1872, while studying living *Rhynchonella* in the St. Lawrence, I observed a specimen protrude its arms to a distance of four centimètres beyond the anterior borders of the shell, a distance nearly equalling twice the length of the shell. This year I again had an opportunity of studying *Rhynchonella* in Hakodate, Yesso, and again observed the same features. Specimens lying on the bottom of a glass dish protruded their arms a short distance and remained in this position for hours. The movements of the arms were very sluggish, though the cirri were constantly in motion. Sometimes the shells closed upon the arms before they were retracted. *Lingula* has the

power of partially protruding its arms, as I have repeatedly observed in North-Carolina and Japanese species. *Terebratulina* can only protrude the cirri."[1]

In the 'Transactions of the Zoological Society,' vol. i, pl. xxii, fig. 14, Professor Owen gives a figure of *Rhynchonella psittacea*, in which he represents one of the arms unfolded. Grundler figured the arms as far back as 1774 ('Naturforscher,' ii, pl. iii, figs. 3 and 4).

Lucas Barrett says[2] that *Terebratulina caput-serpentis*, of which he obtained living specimens daily during two months, protrudes its cirri further than any of the others (*Waldheimia cranium*, &c.). "The cirri on the reflected part of the arms are shorter than those on the first part. The cirri were almost constantly in motion, and were often observed to convey small particles to the channel at their base. When placed in a small glass of sea water the valves gradually opened. Individuals remaining attached to other objects manifested a remarkable power and disposition to move on their pedicles. Detached specimens could be moved about without causing the animal to close its valves. If any of the protruded cirri were touched the cirri were retracted and the valves closed with a snap, but soon after opened again. When the oral arms were retracted the cirri were bent up, but were gradually uncoiled and straightened when the shell was opened, before which action the animal was often observed to protrude a few of its cirri and move them about, as if to ascertain if any danger threatened. Only on one occasion a current was perceived to set in on one side between the two rows of cirri. I had been attempting to ascertain the existence of currents by introducing small quantities of indigo into the water surrounding the animal with a camel-hair brush; three times the water was forcibly drawn in, and particles of indigo were seen to glide along the groove at the base of the cirri in the direction of the mouth." He adds, p. 258, "As in *Waldheimia* with a long loop, the oral arms are so fixed to the calcareous skeleton as to be incapable of motion, except at their spiral terminations; it has been supposed that these conjoined spiral ends could be unrolled, like the proboscis of a butterfly, but I never saw any disposition of the kind manifested. *Waldheimia cranium* is more lively than *T. caput-serpentis*, moving often on its pedicle, also more easily alarmed; the cirri are not protruded beyond the margins of the valves: when the shell is closed they are bent up. In *Crania anomala* the cirri are protruded, but not the arms, beyond the margin of the shell."

Every observation in connection with the animal in life is of the greatest importance and should be carefully noted; thus Dr. Gwyn Jeffreys, who has also watched *Terebratulæ* alive, says ('Brit. Conch.,' vol. ii, p. 8) that they were incessantly opening and folding their brachial or labial appendages, and drawing and sucking-in by means of the whirlpool thus caused every animalcule within their influence; that in *T. caput-serpentis* the cirri open and fold together somewhat like a butterfly-net.

The shape assumed by the labial appendages is very different in some families and

[1] 'American Journal of Science and Arts,' 3rd series, vol. xvii, p. 257, March, 1879.

[2] "Notes on the Brachiopoda observed in a Dredging Tour with Mr. McAndrew on the coast of Norway," 'Ann. and Mag. of Nat. Hist.,' vol. xvi, 2nd series, p. 257, October, 1855.

genera. Hancock says ('Phil. Trans.,' vol. 148, p. 806, 1859) that "the arms, or labial appendages, are normally composed of a membranous tube or canal bearing a semi-cartilaginous ridge. The latter stretches from end to end of the former, and gives support to the fringe of cirri. As far back as the commencement of the spirals the arms are, as above stated, but for the entire length of the lateral portions of the loop, where the arms are doubled upon themselves, and where, of course, two tubes or canals might have been expected, there is only one, the two having, as it were, coalesced. These large canals at the roots of the arms are continuous with those of the spirals, and terminate in blind sacs, one on each side of the œsophagus, close to the mouth. On making a transverse section of this part of the arm, the enlarged terminal portion of the brachial canal is seen connected with the external edges of the dorsal and ventral membranes of the loop; and the pallial lobule, stretching between the inner edges, forms a sort of flattened inner tube. This inner tube opens widely into the perivisceral chamber, and is in fact a prolongation of this chamber, and terminates at the anterior extremity of the lateral portion of the loop, forming what may be designated the brachial pouches." . . . . "The cirri are undoubtedly contractile to some extent, and are also endowed with the power of motion individually, as proved by the observations of Mr. Barrett. It would appear likewise that the entire fringe of cirri can be elevated or depressed, there being ample means provided for the purpose;" he adds the arms of *Wald. cranium* and *Terebr. caput-serpentis* are disposed in the same manner as in *Wald. australis*, but in *T. caput-serpentis* the expanded portions of the arms are without any apophysory support, and accordingly other means are provided to sustain them; also that the arms of *Rhynchonella psittacea* are totally destitute of calcareous support except at their origin, where they are sustained by two hinge-processes or oral laminæ, the points of which reach as far forward as their external margins. Again, he says (p. 810) that "in *Lingula anatina* the brachial organs are strong and fleshy, and rise from the back of the pallial chamber in the usual manner; they are entirely without calcareous support, even at their origin, and form two spiral coils with six or seven turns each, directed inwards and upwards." We must, however, refer our reader for more ample details to the anatomical works already recorded.

The food of the Brachiopoda consists of infusoria and other minute organisms.

In a very interesting paper Hérouard enters into many details on the aqueous currents relating to the nutrition of the Brachiopoda,[1] and to this the reader is referred. In his paper he also proposes a new grouping of the Brachiopoda.

In conclusion we may remark that in some families *Rhynchonellidæ*, *Strophomenidæ*, *Productidæ*, and others, these labial appendages are spirally coiled. In others, *Terebratulæ* and *Lingulidæ*, only at their extremities. It is also almost certain that these beautiful appendages, by means of their cirri and cilia, are not only instrumental in carrying floating nutritious particles and minute microscopical organisms to the mouth (which is situated between the appendages at their origin), but are subservient to the functions of

[1] 'Journal de Conchyliologie' (3 ser., t. xvii), vol. xxv, p. 229, 1877.

respiration. Hancock adds ('Phil. Trans.,' vol. 145, p. 835), that "to prove that the brachial organs subserve the function of gills, as well as that of sustentation, it is only necessary to refer to the manner in which the blood circles round the arms (labial appendages) and is carried to the cirri; but more particularly to its circulating through these latter organs, and to its return direct from them to the heart."

We have now referred to those portions of the animal that more nearly interest the palæontologist, as they leave their impressions on the internal surface of the valves of the fossil. Numerous minute and accurate investigations have also been carried out by the anatomist with respect to the other soft parts of the animal, but to which we can only very briefly refer, as elaborate illustrations would be required in order to render their details comprehensive to the general reader. We have, however, reproduced in Pl. XXI, of this volume Mr. Hancock's three best anatomical figures, showing in a very complete and admirable manner the soft parts of the animal of *Waldheimia australis*, *Rhynchonella psittacea*, and *Lingula anatina*, and to these the reader can refer.

Brachiopoda in the adult condition have neither head nor brain, although Prof. Morse thinks that he has recognised a hearing organ in *Lingula*. Eye-spots are likewise said by several distinguished zoologists to be developed in all embryos of the animal, and that they are to some extent sensible to light. The same was observed by Lucaze-Duthiers in *Thecidium;* for one day, while observing a number of live specimens in a large pail of sea-water, several of them had their valves open, but on leaning, with all due precaution, over the pail, and having interposed his head between them and the rays of the sun, those in the shade instantly closed their valves.

Forbes says in his 'British Mollusca' (p. 340), that ocelli and otolitic vesicles are certainly present in some species if not in all. The digestive organs, muscles, liver, &c., occupy a small space only in the rostral portion of the shell, while the mantle and labial appendages take up all the rest of its internal space. The digestive organs, liver, muscles, &c., are partitioned off from the general cavity by a strong membrane, in the centre of which is placed the animal's mouth; the mouth conducts by a narrow œsophagus to a simple stomach, which is surrounded by a large greenish liver, and is divided into two lobes situated one on each side of the alimentary canal. The digestive organ is minutely described by Hancock at p. 814 of his admirable anatomical memoir already referred to.[1] In *Waldheimia cranium* he states the intestine to be short, terminating in a blind sac before it reaches the perivisceral chamber; and that the membrane lining the intestinal tube of *Wald. cranium* is thick. In *Rhynchonella* the œsophagus, he says, is considerably

[1] It was at my urgent request and repeated solicitations that Mr. Albany Hancock undertook his magnificent series of anatomical researches in connection with the Brachiopoda. The greater portion of the material he worked upon was contributed by myself. I had also the great advantage of seeing his admirable preparations during my repeated visits to Newcastle. These he minutely explained to me in his usual liberal manner. For this splendid contribution to science Mr. A. Hancock was awarded by the Royal Society one of its royal medals, a great honour which he had deservedly earned.

longer than in *Waldheimia*, the mouth approaching much nearer to the ventral valve. The intestine is rather long and gradually tapers downwards. On reaching the ventral valve, directly behind the extremities of the occlusor muscles, it turns backwards and upwards, and, detaching itself from the mesentery, advances a little and terminates in a much enlarged, rounded extremity, which inclines to the right or left, varying in this respect in different individuals.

The alimentary tube in *Lingula*, says Hancock at p. 815 of his work already referred to, "presents two or three interesting modifications. The mouth is perfectly similar to that of *Waldheimia*, and the œsophagus, which is somewhat elongated, is at first depressed; but on emerging backwards from between the anterior occlusors, becomes compressed. The stomach is short, being almost lenticular, and the transverse dorsal ridge is much produced. In front it is slightly convex, where it receives the œsophagus; behind it is a little produced, and an inconspicuous constriction marks the commencement of the intestine, which running backwards, buried beneath the lobules of the liver, and resting above the posterior adjustor muscles, gradually descends towards the ventral lobe, immediately in front of the divaricator muscles. The straight portion of the intestine corresponds to the entire intestine of the Articulated Brachiopoda, and it thus appears that in *Lingula*, as well as in them, the first inflection of the intestinal tube is towards the ventral surface. From thence the tube bends to the left, and, turning forwards and upwards, forms two large loops at the posterior portion of the perivisceral chamber; it then advances along the right side, and dipping under the dorsal extremities of the adjustor muscles and the pseudo-heart, opens through a nipple-like anus, situated at the right side of the body between the margins of the mantle. The anal orifice is ample, and is very easily distinguished; it is placed considerably nearer to the dorsal than the ventral surface. The calibre of the alimentary canal does not vary much; the stomach only being a little enlarged, &c."

The nervous system has been likewise elaborately described by Owen, Hancock, Bemmelen, and others, and its condition of development is lower than that of the Lamellibranchs. Hancock again says (p. 845) that the collar in *Waldheimia* "is situated at the commencement of the alimentary tube, and there are five nervous centres, three of which, on account of their superior size, may be assumed to be the principal œsophageal ganglia." Van Bemmelen states (see 'Ann. and Mag. of Nat. Hist.,' 5th series, vol. xi, p. 381, 1883) that the central nervous system consists of a circumœsophageal ring, which not only shows a large infraœsophageal but also a supraœsophageal ganglion. Both these centres give origin to arm-nerves; the nerves of the supraœsophageal are even more important than those of the other ganglion. The nervous centra are formed by thin nervous fibres and very small cells, the peripheral nerves by parallel fibres only, between which nuclei of connective tissue, or perhaps of nervous elements, are to be found. The nerve-arms are surrounded by and connected with a ganglionic plexus, situated in the supporting tissues of the arm-walls immediately under the ectodermal epithelium,

and formed of large multipolar cells and nucleated protoplasmic threads, intercommunicating so as to form a network. No connection with the neighbouring epithelial cells has been discovered; though it seems very probable the connection exists."

I have said enough to show how great has been our advance in knowledge with respect to the animal of the Brachiopoda during the present century, or rather within the last forty years. Much, however, has still to be made clear before the subject will have been exhausted.

Habitats and Ranges in Depth.—As is well known, Brachiopoda are inhabitants of the sea; and very much correct and valuable information concerning their habitats has been obtained during the last fifteen years, and especially so with respect to their bathymetrical and geographical distribution. Many important dredging-reports have been issued from time to time, and we cannot proceed without especially alluding to a report on the Mollusca and Radiata of the Ægean Sea by that able and distinguished naturalist, Professor Edward Forbes, read before the British Association for the Advancement of Science, for 1843. Although the views entertained by Forbes with respect to the "provinces of depth" have not been generally substantiated, still his researches were at the time so new and so important that they stimulated in others a desire for further investigation in the same direction.

This important knowledge is therefore mainly due to the numerous well conducted and equipped dredging-expeditions carried on by private individuals, and by the Governments of leading maritime states. Previous to these investigations the data we possessed with respect to the habitat and range of depth was in most cases erroneous, vague, and unsatisfactory. It was also ascertained that the Brachiopoda are much localised, and that, being very prolific, they usually occur in vast numbers in their favourite haunts. They do not occur everywhere, for throughout a course of 68,890 miles, the "Challenger" dredge was put down at some 361 stations, and Brachiopoda were brought up thirty-eight or thirty-nine times only. In some districts they are specifically numerous, for instance, some thirty species have been got from the Japanese and Corean waters; but this is the exception, not the rule.

Dr. Gwyn Jeffreys, who has had much experience in dredging-operations, states in vol. ii, p. 2, of his 'British Conchology,' that "the comparative rarity of Brachiopoda in modern times may be easily accounted for. They mostly inhabit rocky and stony parts of the sea-bed, which cannot be reached by the dredge without great risk of its being lost or injured, although they are gregarious and occur in vast numbers under favorable circumstances. My late friend, Dr. Lukis, found more than 200 specimens of *Argiope cistellula* on a single stone brought up from a depth of twenty fathoms off Guernsey, and I myself have repeatedly taken *T. caput-serpentis* and *Crania anomala* in such profusion, on the western coast of Scotland, as to be compelled by sheer *embarras des richesses* to throw away many hundreds overboard in the course of a day's dredging. Even the comparatively rare *T. cranium* is no exception. I have counted seventy specimens,

although broken and imperfect, which came up in a single haul off the Shetland." Some species are very abundant on coral-reefs.

Having in 1879 been requested by Sir Wyville Thomson to undertake the examination, description, and illustration of the Brachiopoda dredged by the celebrated "Challenger" expedition during the years 1873—1876. I availed myself of that opportunity to carefully study and examine all the recent forms of the class then known, and I drew up a catalogue of them with indications of the habitats and ranges of depth at which each species had been obtained.[1] From that investigation it resulted that we are acquainted with about some 100 so-termed species and named varieties of the *Clistenterata*, and of the *Tretenterata* about thirty-two: of these a list will be found further on.

The range in depth of one and the same species is often very variable. Thus, for example, as far as our present information will carry us, the *Tretenterata* (*Lingula*, &c.) do not appear to have been found at greater depths than from 1360 to 2000 fathoms. *Lingula* and *Glottidia* abound in particular spots, and live at about half-tide mark and partly buried in mud, or at depths varying from three or four inches from the surface of the sea to seventeen fathoms. Morse describes a species (*Glottidia pyramidata*) which he found in vast numbers in a sand shoal at low water: the peduncle, six times the length of the shell, was partly encased in a sand-tube, of which a figure will be found at p. 329 of this Summary.

The species of these genera are very abundant where they occur. Of one species (*Lingula anatina*) the "Challenger" Expedition brought home several hundred specimens, all obtained on the beach at Zamboangan; Philippines, and Mr. Cuming (the great collector of shells), when at Manilla in 1836, after an unusually boisterous typhoon, collected as many as twenty bushels on the shore. They are made use of as articles of food, and Prof. Morse tells me he has eaten them. *Discina* has been found attached to stones at low-water mark, and at depths not exceeding forty-nine fathoms. One far-spread form, however (*Discina atlantica*, King), has been dredged at depths ranging from 690 to nearly 2425 fathoms.[2]

[1] Davidson, "The Challenger Reports," 'Zoology,' vol. i, part 1, 1880. Prof. Suess published a list of the depths known up to 1859 in a paper entitled "Über die Wohnsitze der Brachiopoden" (aus den xxxvii und xxxix Banden d. Wien. Akademie der Wissenschaften besonders abgedruckt, 1859—1860.

[2] This small shell, not exceeding two lines in length and rather less in breadth, was obtained for the first time through the soundings and dredgings conducted by Staff-Commander R. Hoskyn, R.N., for purposes in connection with the then proposed telegraphic communication between Ireland and Newfoundland in 1862, and since then has been dredged in no less than eight or nine separate and widely-spread localities. It appears to be very abundant in its haunts, and occurs only at very great depths. It has, like all other abyssal forms, a very thin shell, and was obtained by the "Challenger" Expedition at eight stations. Its cirri are of great length, and barbed throughout with spine-like asperities. It was described for the first time by Prof. Dr. W. King, in the 'Proceedings of the Natural History Society of Dublin,' 1868. Sir James Anderson showed me two specimens he had got while fishing up the deep-sea telegraph cable, 2400 fathoms; and Dr. Gwyn Jeffreys gave me some specimens of the shell which he had dredged on the return voyage of H.M. Ship "Valorous" from Davis Strait.

Many of the species of *Discina* and *Discinisca* (Dall) live clustered together in vast numbers, and adhering, in all their stages of growth, by their peduncle to the surface of the shell of their neighbour, one above the other, till they form a living mass of considerable breadth and thickness. Thousands of *Discinisca lævis* or *lamellosa* were obtained by Mr. F. H. Brady at Callas, Peru, and a number of them in this condition were sent to me in 1872 by Prof. Verrill. Rocks in which *Lingula* and *Discina* are found would therefore indicate seas of very moderate depth, for we have no reason to suppose that the same kind of animal, in times long past, differed materially in its mode of living.

Crania occurs in great numbers, adhering to stones, shells, branches of corals, &c., at moderate depths; but one species, *C. anomala*, is said to have been got at depths varying from three to 808 fathoms. The genera and species of *Clistenterata* are found at depths ranging from about half-tide mark to 2900 fathoms, *Terebratula Wyvillei* (Dav.) having been obtained at the last-named depth in the Middle North Pacific; it is an exceedingly thin glassy shell. Another form was dredged by the same Expedition 300 miles east of St. Paul's Rocks, Atlantic, at a depth of 1850 fathoms; but the larger number of species live at depths of from 5 to 300 or 400 fathoms, attached by their peduncles to various marine objects, and very often to the outer surface of one another's shell; and even young individuals to the peduncle of the parent shell, as I found to be very commonly the case with specimens of *Terebratulina septentrionalis* brought back by the "Challenger" Expedition, and in others given to me by Prof. Verrill. On a clustered specimen of the last-named species, dredged at Lockport and measuring one inch in length by three quarters of an inch in breadth, I counted thirty-seven young individuals attached, and varying from the size of half a line in length up to five. *Terebratulina septentrionalis*, as shown by Morse, varies much in shape during its growth. In quite young examples the ribs are very few in number, but become gradually more numerous as the shell increases in size. I have likewise clusters of *Terebratella rubicunda* from New Zealand seas, as well as of *Waldheimia flavescens*, adhering to each other in a similar manner and profusion. Some forms occur also in great numbers fixed by a shorter or longer peduncle to coral-reefs; and several minute species were found by Dr. Gwyn Jeffreys attached to seaweeds. *Kraussina rubra* from the coast of Natal in South Africa was described by Dr. Gray and myself as having been found attached in vast numbers to Ascidia and stems of seaweeds.

We may likewise note that a small species of *Kraussina*, (*K. Davidsoni*) was obtained by M. Vélain (during the French Expedition to make observations relative to the transit of Venus) in the interior of the breached and sub-merged crater-basin of the Island of St. Paul, attached in vast numbers to rocks at low-tide mark. I am also informed by the same distinguished geologist that during the ordinary low tides they are scarcely covered by water, are alternately covered and left bare at the ebb and flow of the tide, and twice a month are left completely dry. They occur only in a vertical area of a few yards in that region, and consequently at very shallow depths.

Dr. Gwyn Jeffreys says ('British Mollusca,' vol. ii, p. 9) that *Terebratulina caput-serpentis* was found by the Rev. M. G. Berkeley, in a living state, attached to a rock at low water, on a part of the Scottish coast where the tide falls only a few feet. The same species is found at variable depths, having been dredged alive from depths varying from 3 to upwards of 150 fathoms.

Dr. Gwyn Jeffreys does not believe that the habitat of any invertebrate animal is affected by bathymetrical conditions, but I cannot imagine that this can in some cases be entirely correct. The late Prof. J. Beete Jukes collected large numbers of *Waldheimia flavescens* while boating among the reefs; they were merely washed by the tide, and he gathered them with his hands like limpets on the shore. In 1834 Quoy and Gaimard found the same shell in immense numbers at Port Western, Bass Strait; they tell us that hundreds were brought up at each haul of the dredge, either grouped among themselves or attached to other shells. 'Voyage de l'Astrolabe,' 1834, p. 552.

I have, for many years, devoted considerable attention to the study of Recent and Tertiary Brachiopoda, making a large and instructive collection, because it is more easy to observe variations in age, shape, and character in them than it is always so with the older fossils. It is wonderful, for instance, to observe in a couple of hundred specimens of *Waldheimia flavescens* the variety in shape that the same form will assume, and which, if fossil, would have tempted the palæontologist to found out of them half a dozen so-termed species.

The colours recent species assume are most remarkable and instructive. Some present various shades of white and yellow, livid and horny brown, red and pink, reddish-brown, and different shades of green to brilliant evergreen, blue-green, &c. Similar colours adorned the fossil forms, but in most cases are for ever lost to us. Traces, however, of the original colour, although not vivid, are sometimes seen; several instances have been noted and illustrated in the pages and plates of this Monograph.

The study of the recent species is therefore of much importance, and has progressed in a satisfactory manner during the last few years. Much, however, has still to be done in this respect, and the more the sea-bottoms are explored will our knowledge of the subject be increased. Recent species have been classed in about twenty-two genera or sub-genera; but we are not yet in a position to offer a complete list of the good species, so many doubtful and uncertain ones having been proposed from time to time from the inspection of single specimens, which may be, and are very possibly, varieties of some of the others.

The largest recent Brachiopod that has come under my notice is a specimen of *Waldheimia venosa*, Solander,[1] measuring 3 inches 2 lines in length, by 2 inches in breadth and 1 inch 11 lines in depth. It had been obtained alive by Rear-Admiral B. J. Sullivan, in the outer harbour of Fort William, Falkland Islands, in 1843, the

[1] In 1789, in 'A Voyage round the World,' G. Dixon described and figured (Appendix I, p. 355) a specimen of this remarkable species:—"At Falkland's Islands we met with a curious kind of shell of the *Anomia* genus of Linnæus, of which, though the species are numerous in a fossil state in most parts of the

locality from whence Capt. Dixon procured his smaller shell. The largest Tertiary specimen of a Brachiopod, *Terebratula grandis*, measures 4½ inches in length by 3 inches 2 lines in breadth, and 2 inches 2 lines in depth. It is remarkable that the largest Tertiary species should be a *Terebratula* with a short loop, and the largest recent form a *Waldheimia* with a long loop.

I here append a list of the recent species known to me, and which I published at page 11 of my 'Report on the Brachiopoda' dredged by Her Majesty's Ship "Challenger." (An asterisk has been placed before the names of those so-called species which require further investigation.)

CLISTENTERATA, *King*.

	TEREBRATULA	vitrea, *Born*. 1780.		TEREBRATULINA	Wyvillei, *Dav.*[2] 1878.
	—	— var. minor, *Philippi*. 1836.		—	Crossii, *Dav*. 1882.
*	—	— var. Davidsoni, *Adams*. 1867.		—	japonica, *Sow*. 1847.
*	—	— var. sphœnoidea, *Philippi*. 1844.		—	radiata, *Reeve*. 1871.
				—	caput-serpentis, *Linné*. 1767.
*	—	— var. cernica, *Crosse*. 1873.		—	— var. mediterranea, *Jeff*. 1878.
	—	cubensis, *Pourtales*. 1867.		—	— var. septentrionalis, *Court*. 1838.
	—	Moseleyi, *Dav*. 1878.		—	cancellata, *Koch*. 1843.
	—	Wyvillii, *Dav*.[1] 1878.	*	—	Cumingi, *Dav*. 1852.
	—	subquadrata, *Jeffreys*. 1878.	*	—	trigona, *Jeffreys*. 1878.
	—	uva, *Broderip*. 1833.	*	—	tuberata, *Jeff*. 1878.
*	—	? Dalli, *Dav*. 1878.	*	—	patagonica, *Gould*. 1850.
*	—	Malvinæ, *d'Orb*. 1847.			

globe, few have been discovered recent or fresh from the sea. Only one of this sort was before known in Europe, which was brought over by my late worthy commander, the much regretted Captain Cook, in his first voyage round the world. It was in the Portland Museum, and was named by the late celebrated Dr. Solander, in his MS. description of the shells of that splendid cabinet, *Anomia venosa*, which specimen is now in the collection of Mr. Calonne, of London. This kind (as do all that are properly of this genus) adheres to coral rocks by a ligament that comes from the animal through the hole in the larger valve. The internal structure (peculiar to the shells of this genus) is very singular, and consists of two testaceous rays, which commence near the hinge in the lesser valve, where they adhere, from whence leaving the shell they proceed to near the edge, then bend towards the outer valve, and turn back to their commencement, where they unite. This internal part is very delicate, and breaks upon the smallest touch, but is thicker in the part nearest to the larger valve. The shell takes its name from certain parts of the animal, which run in a branched form along the inside of the shell, which being held to a strong light, or a candle, gives it a beautiful veined appearance. The outside is smooth, and of a pale brown colour." I reproduce this description, as the book seems little known, but remarkable for the period at which it was written.

[1] This remarkable deep-sea species bears much resemblance to the Jurassic *T. nucleata* of Schlotheim, and their loops are identical.

[2] *Terebratulina Wyvillei* is the largest recent or fossil species of the genus with which I am acquainted. It measures 2½ inches in length, 2 in breadth, and 1 inch 4 lines in breadth. *Terebratulina Crossii* is the second largest form, measuring 2 inches 1 line in length, by 1¾ inch in breadth, and 1 inch in depth.

*Terebratulina Cailleti, *Crosse.* 1865.
* — unguiculata, *Carpenter.* 1865.
* — Murrayi, *Dav.* 1878.
— (Agulhasia) Davidsoni, *King.* 1871.
*Gwynia ? capsula, *Jeffreys.* 1859.
Waldheimia flavescens, *Valensienne.* 1819.
— venosa, *Solander.* 1788.
— cranium, *Müller.* 1870.
— tenera, *Jeffreys.* 1876.
* — Wyvillei, *Dav.* 1878.
— kerguelensis, *Dav.* 1878.
— floridana, *Pourtales.* 1868.
— lenticularis, *Deshayes.* 1841.
— septigera, *Loven.* 1846.
— Raphaelis, *Dall.* 1870.
— Grayii, *Dav.* 1850.
Terebratella dorsata, *Gmelin.* 1778.
— frontalis, *Middendorf.* 1849.
— Mariæ, *Adams.* 1860.
— coreanica, *Adams.* 1850.
— cruenta, *Dillwyn.* 1817.
* — Bouchardi, *Dav.* 1852.
* — occidentalis, *Dal.* 1871.
* — pulvinata, *Gould.* 1850.
* — Frielii, *Dav.* 1878.
— rubicunda, *Solander.* 1899—1803.
— spitzbergensis, *Dav.* 1852.
— transversa, *Sow.* 1846.
* — rubiginosa, *Dall.* 1870.
* — labradorensis, *Sow.* 1846.
* — algoensis, *Sow.* 1846.
* — Lamanoni, *Schrenk.* 1867.
*Magasella[1] flexuosa, *King.* 1835.
* — Gouldi, *Dall.* 1871.
* — Adamsi, *Dav.* 1871.
* — aleutica, *Dall.* 1872.
* — crenulata, *Sow.* 1846.
* — lævis, *Dall.* 1870.
* — radiata, *Dall.* 1877.
* — suffusa, *Reeve.* 1861.
* — Cumingi, *Dav.*[2] 1852.
*Magasella fibula, *Reeve.* 1861.
* — lupina, *Phil.* 1845.
* — inconspicua, *Sow.* 1846.
* — Evansi, *Dav.* 1852.
Laqueus californicus, *Koch.* 1843.
— pictus, *Chemnitz.* 1785.
— rubellus, *Sow.* 1846.
Megerlea truncata, *Linné.* 1767.
— — var. monstruosa, *Scacchi.* 1833.
* — incerta, *Dav.*[3] 1878.
Ismenia sanguinea, *Chemnitz.* 1785.
— Willemoesi, *Dav.* 1878.
* — Jeffreysii, *Dall.* 1871.
Kraussina rubra, *Pallas.* 1866.
— pisum, *Lam.* 1819.
* — cognata, *Chem.* 1785.
— Lamarckiana, *Dav.* 1852.
— Davidsoni, *Velain.* 1878.
— capensis, *Adams.* 1850.
— Atkinsoni, *Wood.* 1877.
Bouchardia rosea, *Mawe.* 1823.
Platydia anomoides, *Scacchi.* 1844.
— Davidsoni, *Deslongchamps.* 1855.
* — lunifera, *Philippi.* 1836.
Argiope decollata, *Chemnitz.* 1785.
Cistella cistellula, *Wood.* 1840.
— neapolitana, *Scacchi.* 1833.
— Barrettiana, *Dav.* 1866.
— — var. lutea, *Dall.* 1871.
— Woodwardiana, *Dav.* 1866.
— cuneata, *Risso.* 1826.
* — Schrammi, *Crosse.* 1866.
— — var. rubrotincta, *Dall.* 1871.
Thecidium mediterraneum, *Risso.* 1826.
— Barretti, *Woodward.* 1864.
Atretia gnomon, *Jeffreys.* 1878.
Rhynchonella psittacea, *Gmelin.* 1788.
— sicula, *Seguenza.* 1878.
— nigricans, *Sow.* 1846.
— — var. pixydata, *Watson.* 1878.
— lucida, *Gould.* 1860.

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[1] I am not certain that *Magasella* is a good genus. The species so referred are perhaps undeveloped forms of *Terebratella*. The subject will demand careful investigation.

[2] This is an excellent and well-characterised species, but its exact generic position is not yet quite determined. *T. fibula* is probably only a large individual of *T. Cumingi*.

[3] The so-termed *M. incerta* is a good and distinct species, but the genus to which it should be referred is still an open question.

TRETENTERATA, *King*.

LINGULA anatina, *Lam.* 1819.
— exusta, *Reeve.* 1861.
— hians, *Swainson.* 1823.
— hirundo, *Reeve.* 1861.
— jaspidea, *Adams.* 1863.
* — lepidula, *Adams.* 1863.
— Reevei (ovalis), *Dav.* 1880.
* — smaragdina, *Adams.* 1863.
* — Adamsi, *Dall.* 1873.
— tumidula, *Reeve.* 1841.
* — Murphiana, *King.* 1861.
* — affinis, *Hancock.* 1858.
GLOTTIDIA antillarum, *Reeve.* 1861.
— Audebardi, *Brodrip.* 1833.
* — semen, *Broderip.* 1833.
GLOTTIDIA Palmieri, *Dall.* 1871.
— albida, *Hinds.* 1844.
— pyramidata, *Stimpson.* 1860.
CRANIA anomala, *Müller.* 1776.
— — var. alba, *Jeffreys.* 1869.
— — var. Pourtalesi, *Dall.* 1871.
— japonica, *Adams.* 1863.
— Suessi, *Reeve.* 1862.
DISCINA striata, *Schumacher.* 1817.
DISCINISCA lamellosa, *Broderip.* 1833.
— lævis, *Sow.* 1822.
— Cumingi, *Broderip.* 1833.
— atlantica, *King.* 1868.
* — tenuis, *Sow.* 1847.

Several monographs and many papers have been published on the Recent Brachiopoda, but those by G. Sowerby[1] and L. Reeve[2] contain the larger number of species, and their figures are very good. Reference to the other works and papers on the subject will be found in the Brachiopod Bibliography.[3]

It resulted from my examination of the Brachiopoda dredged by the "Challenger" Expedition that animals of the same species are capable of existing at different depths without any observable modification in shape or character.

The ranges in depth noted in the list published in the "Challenger" Report and from other sources are even now sufficient to warrant us in arriving at certain general inductions. Thus, for sake of argument (for all we can say on the subject must necessarily be provisional), suppose we put down the number of recorded recent species, and named varieties, at 135, that is to say 125 species and 10 named varieties, a number that will certainly have to be largely reduced, or say 107, as nothing is known respecting the ranges of 25 or 26 so-called species.

From the shore to 500 fathoms there are some 98 species or named varieties; 12 of these ranging up to 100 fathoms or less.

From 501 to 1000 fathoms some 16 species. Of these only one, *Discina atlantica*, ranges from 690 to 2400 fathoms.

From 1001 to 1500 fathoms some 6 species. Of these *Terebratula Wyvillei* ranges from 1035 to 2900 fathoms, the greatest depth at which any species has been found.

[1] The 'Thesaurus Conchyliorum,' 1846, parts vi and vii.

[2] Monographs of the genera *Lingula*, *Orbicula*, and *Terebratula*, 'Conch. Icon.,' 1860—1862. Chemnitz in 1785, 'Neues systematisches Konchylien-Kabinet,' vol. viii, described and figured a number of recent Brachiopoda, but his illustrations do not equal those of Sowerby and Reeve.

[3] British recent Brachiopoda have been minutely described and illustrated by Forbes and Hanley in their work on 'British Mollusca' in 1849, and by Dr. Gwyn Jeffreys in volumes 2 and 5 of his 'British Conchology,' 1863 and 1869.

From 1501 to 2000 fathoms 4 species. From 2001 to 2900 fathoms 3 species.

Thus out of 107 species some 57, or about half the known species, were dredged at a depth of less than 100 fathoms; 20 to 25 at low-water mark or from 5 to 10 fathoms; and the remainder at about 50 to 60 fathoms.

These numbers must, however, as I have already said, be considered as strictly provisional, and as the result of our present experience; but they are sufficient to indicate that the majority of known species live at comparatively small depths ranging up to 500 fathoms, and that Brachiopods have hitherto proved themselves to be specifically rare at depths of from 500 to 2900 fathoms.

Fossil genera and species; and Classification.

An accurate knowledge of the Families, Sub-families, Genera, and Species that compose the *Brachiopoda* is a matter of considerable importance to the Stratigraphical Geologist, for these fossils occur under a multitude of characteristic forms in our sedimentary or fossiliferous deposits, and assist in defining geological epochs and horizons. Little, however, seems to have been achieved in this direction during the years that elapsed between 1606 and 1700 in addition to the short notices of Colonna in 1606 and 1616; Worms in 1655, Lister in 1688,[1] Llwyd in 1699,[2] and a few others. The last two named authors being the first, as far as I am aware, who published brief notices and figures of a few of our British species, and which are in most cases easily recognisable.

During the following century, or from 1700 to 1800, a much larger number of naturalists described and figured fossil Brachiopoda; but one should scarcely say *described*, for in most cases they knew very little of the true nature of the animals they had before them.

If we cast a glance at the works of Langius 1752, Morton 1712, Klein 1753, Stobæus 1731, Bourguet 1742, Scheuchzer 1752, Andrea 1763, Knorr 1753, Davila 1767, Retzius 1781, Hupsch 1781, Faujas de St. Fond 1799, Walcott, 1799, and of others whose names and works will be found recorded in the Brachiopod Bibliography, we shall appreciate the immense amount of real and accurate work afterwards achieved, during the years between 1800 and 1884. The rules of nomenclature laid down by the immortal Linnæus in 1753—1767, having been adopted by the British Association and by the scientific men of every country, proved a very great boon to science.[3]

[1] 'Historia sive Synopsis methodica Conchyliorum,' Appendix to vol. iii, 1688.

[2] 'Lithophylacii Britannici Ichnographia,' 1699, 2nd ed., 1760.

[3] Linné's types are in the possession of the Linnæan Society of London, and have been carefully studied by J. W. Salter, D. Sharpe, S. Hanley, and myself (see Hanley's 'Ipsa Linnæi Conchylia,' London, 1855. Linné kept his specimens in small square tin boxes, and sometimes examples belonging to more than one species had got mixed together. Since they came into the possession of the Linnæan Society they have been mounted upon tablets, and, as far as such was possible, correctly identified and

Bruguière in his 'Histoire naturelle des vers,' published in 1789—1792, devotes eight quarto plates to figures of recent and fossil Brachiopoda, and therein proposes his excellent genus *Lingula*, which he figures in Plate 250 of that work. All the other species on the plates are classed as *Terebratulæ*, and include forms we now distinguish by the generic names of *Terebratula, Terebratulina, Terebratella, Terebrirostra, Waldheimia, Megerlea, Kraussina, Rhynchonella, Spirifer, Athyris, Strophomena*. Bruguière's plates are fairly good, the species figured being in most cases determinable.

Although we are compelled to speak somewhat lightly of the larger portion of work accomplished between 1606 and 1800, it is, however, just and fair to state that some of these early investigators materially helped to bring the subject under the special notice of the more experienced zoologists and palæontologists that succeeded them. A few also, as already stated, had endeavoured to describe and illustrate some of the soft parts of the animal; but it was only after the animal of the recent species had been thoroughly anatomically investigated that it became possible to interpret the various markings and impressions observable on the interior surface of the valves in the extinct genera and species that were being constantly discovered.

Step by step, we at first slowly advanced, as it were groping our way in the dark or twilight, often obliged to retrace our steps and to abandon preconceived ideas and hasty conclusions, which facts and further study refused to confirm. This has many times been my own lot during the forty and more years I have devoted to the careful study of the class.

Having already referred to the very important labour accomplished by the zoologist and anatomist with respect to the animal of the Recent Brachiopod, we will now very briefly allude to the work achieved by the palæontologist and more especially by British investigators during the present century.[1]

labelled. All Linné's different editions of his 'Systema Naturæ,' with annotations by the author, are also carefully preserved in the Library of the Linnæan Society, where they can be readily consulted.

[1] In 1712 S. G. Morton, in his 'Nat. Hist. of Northamptonshire,' made reference to some species of British fossil Brachiopoda.

In 1793 David Ure, in his 'History of Rutherglen and East Kilbride,' gave some good figures of several Scottish Carboniferous Brachiopoda.

In 1797 W. Martin, in vol. iv, p. 44, pls. iii and iv, of the 'Transactions of the Linnæan Society of London,' gave very good figures of some English Carboniferous Brachiopoda.

In 1799 J. Walcott, in his 'Descriptions and Figures of Petrefactions near Bath,' reproduced Llwyd's figures of British Jurassic Brachiopoda.

Prof. Mosely, F.R.S., of Oxford, has kindly given me the following description of a recently invented automatic section-cutting machine:—"The method of cutting sections mechanically has been invented for biological work generally, and has been applied to the particular case of the Brachiopoda by Prof. Caldwell, of Cambridge. The machine is similar in construction to the inclined flat section-machine in ordinary use by hand, but instead of the knife being moveable it is fixed, and the object to be cut is moved against it. The thickness of the section is regulated, as in the ordinary machine, by a long fine screw.

Very few genera had been proposed for the Brachiopoda during the 17th and 18th centuries; the species then known being placed chiefly under *Anomia, Terebratula*, and *Lingula*, and no really serious attempt at classification having been attempted.

The progress effected in our knowledge of the fossil forms and their classification has been immense, especially during the last forty years, as testified by the great number of large works and papers in which both recent and fossil Brachiopoda have been described and beautifully illustrated.

For some years subsequent to 1800 the number of families and genera into which the Brachipoda were divided continued very small; and in the General Introduction to Volume I of this Monograph will be found an account of what was known upon the subject up to 1853.

The absolute necessity of separating the *Rhynchonellæ* from the *Terebratulæ* had been foreseen even by early naturalists. Morton in 1712 seems to have been among the first to arrange his *Terebratulæ* into two *distinct* divisions; in the first he placed those species with a *truncated beak*, and in the second those in which the beak is acute and *entire;* these divisions corresponding—the first to the genus *Terebratula*, the second to that of *Rhynchonella* of modern authors. Davila in 1767 likewise alluded to the distinction between these shells, and noticed the difference in their apophysary system; but it is to Gotthelf Fischer de Waldheim that the credit is due of having introduced the generic name of *Rhynchonella* in a paper entitled "Notice des Fossiles du Gouvernement de Moscou, servant de programme pour inviter les membres de la Société Impériale des Naturalistes à la Séance publique du 26 octobre à Moscou 1809;"[1] his type being the *Rhynchonella Loxia*, a shell very abundant in the Jurassic rocks of the neighbourhood of Moscow. He also gave the name of *Rhynchonella "canard"* to another species, figured by Bruguière in Tab. 245, fig. 6, of the 'Encyclop. méthodique,' and *Rhynchonella "aigle,"* 'Ency.,' Tab. 246, fig. 1, which last is a Jurassic or Cretaceous *Rhynchonella*.

This was a valuable addition to our knowledge; but this important and long-lived genus was quite ignored for many years subsequent to its publication; geologists and

The whole is automatic, being worked by water-power taken from an ordinary tap. The substance to be cut is embedded in paraffin of a particular melting-point, which must be varied with the temperature of the laboratory at the time, a matter easily arranged. The subject, supported by the paraffin, is moved very rapidly backwards and forwards against the horizontal knife, and a series of sections of any desired fineness are thus cut. Each fresh section formed strikes the edge of the section formed at the preceding blow against the knife and adheres to it. Thus, a continuous riband of sections emerges from the machine with considerable rapidity, and it is only necessary to cut off lengths from it and receive them on slides, the great advantage being that they maintain their order exactly, and that no fragment is lost. It is possible to cut sections similarly in a riband by hand; but the work is done much more uniformly, and rapidly, and certainly by the automatic machine prepared by the Cambridge Instrumental Company. The paraffin is removed by warmth and benzine, and the sections are then mounted in Canada balsam."

[1] This paper seems to be very scarce. I had the greatest trouble in obtaining a copy of it. One may be seen, however, in the Library of the Linnæan Society of London.

palæontologists persisted in mixing up the shells belonging to the *Terebratulæ* and *Rhynchonellæ* under the single name of *Terebratula*. Baron von Buch in his valuable work 'Ueber Terebrateln' published in 1834, strange to say, ignored it entirely.[1]

To Fischer we are likewise indebted for two more papers, one published in 1825, 'Notice sur la *Choristité*,' and the other in 1829 entitled 'Sur le système apophysaire, ou charpante osseuse des Terebratules,' in which he gives incomplete figures of the spiral appendages of *Spirifer* and *Athyris* (*?*) which he had failed to understand; he even declined to admit Sowerby's excellent genus *Spirifer*.

In 1812 James Sowerby, in the 'Mineral Conchology,' commenced his description of the British fossil Brachiopoda, and continued it to 1822; the work after that date, and up to 1845, being carried on by J. de C. Sowerby.[2] To James Sowerby we are indebted for the creation of the genera *Pentamerus* (in 1813), *Productus* (in 1814), *Magas* (in 1816), and *Spirifer* (in 1816), all excellent genera; but he likewise seems to have been unacquainted with Fischer's *Rhynchonella*.[3]

To William Smith, British geology must ever feel grateful for having introduced his most valuable work 'Strata identified by Fossils,' June, 1816. In that work several British Brachiopoda are figured and placed in their correct stratigraphical position.

It is not my intention here to allude to the many, too many I fear, genera that have been proposed from time to time by palæontologists during the present century. Many of these are very valuable; but perhaps the larger number have been repudiated.[4]

In 1830 Dr. C. H. Pander published his remarkable work 'Beiträge zur Geognosie des Russischen Reiches,' in which he proposes the genera *Porambonites*, *Gonambonites*, *Orthambonites*, *Pronites*, *Hemipronites*, and *Plectambonites*. He also admitted Fischer's genus *Rhynchonella*;[5] but only a very small number of his genera have been retained, many of these being synonyms of the other.

[1] That work at the time of its publication did more than almost any other to stimulate researches in connection with the Brachiopoda; and through it I was mainly induced to take up the subject, being at the same time strongly urged to do so by the learned Baron himself. His work above alluded to was followed by several others. In 1837 appeared his memoir 'Über Delthyris oder Spirifer und Orthis.' In 1841 his 'Über Productus oder Leptœna' was issued; and in 1847 was published his memoir 'Über *Spirifer Keilhavi*.' Several of the above-named monographs were subsequently translated into French and published in the 'Mémoires de la Société Géologique de France.'

[2] In the 'Bulletin de la Société Vaudoise des Sciences Naturelles,' 1855, M. E. Renevier published a useful paper, entitled "Dates of the Publication of the Species contained in the Plates of Sowerby's Mineral Conchology of Great Britain."

[3] The claims of the genus *Rhynchonella* have been ably advocated by M. C. Rouillier in the volumes of the 'Bulletin de la Société Impériale des Naturalistes de Moscou' for years 1844—1849.

[4] A list of the genera of Brachiopoda up to 1856 is given by Prof. E. Suess at p. 158 of his German edition of my General Introduction published in Vol. I of my 'British Fossil Brachiopoda;' also by Mr. W. Dall in his 'Index to the Names which have been applied to the Subdivisions of the Class Brachiopoda previous to the year 1877.' Since then several more have been proposed.

[5] Pander's work is exceedingly scarce and hardly procurable.

To Prof. W. King we are greatly indebted for many excellent remarks on the Brachiopoda, which have added very materially to our knowledge of the class. His first paper, published in 1846, was followed in quick succession by several others; these culminated in the production of the valuable Monograph 'On English Permian Fossils.' To him we owe several excellent genera, and in particular for *Waldheimia*, *Dielasma*, *Megerlia*, *Camanophoria*, *Strophalosia*, and some others.

To Prof. James Hall also we are indebted for the introduction of numerous genera, which will be found recorded in the sequel. In 1847, Alcide d'Orbigny, a very eminent French Palæontologist, added also largely to our knowledge of the Brachiopoda. He originated several good genera, now generally adopted.

These most valuable investigations have been steadily prosecuted by a large number of able Palæontologists who have also from time to time proposed schemes of classification. Space unfortunately will not admit of here recording in detail the honoured names of all those who have contributed to the knowledge we at present possess upon this important subject, but we cannot pass under silence those of MM. d'Archiac, Abich, de Blainville, Billings, Barrande, Brogger, Barrois, Bosquet, Beyrich, Bayle, Bronn, Buckman, von Buch, Canavari, Coquand, Carpenter, Defrance, Deslongchamps (father and son), Dalman, Douvillé, Derby, Deshayes, Dall, Dittmar, d'Eichwald, Etheridge, Favre, Geinitz, Glass, Goldfuss, Gruenewaldt, Gemellaro, von Hagenow, Hall, Hisinger, Haas, von Helmersen, Hoeninghaus, Jeffreys, de Koninck, Kutorga, von Keyserling, Kayser, Klipstein, Linné, Lindström, Linnarrson, de Loriol, Lamarck,[1] Lundgren, Laube, Leymerie, Meek, M'Coy, Morris, Meneghini, Möller, Miller, Moore, Marcou, W. Martin, Michelotti, Massalongo, Nicholson, Nilsson, Oehlert, Ooster, Oppel, d'Orbigny, Pander, Philippi, Phillips, Pictet, Parona, Pähler, Pusch, Portlock, Quenstedt, Roemer, Rathbun, Rouillier, Reuss, Salter, Suess, Sandberger, Seguenza, Schlotheim, Schloenbach, Semenow, Sharpe, Schrenk, Schnur, Shumard, Schmidt, Schauroth, Stoliczka, Szajnocha, Steininger, Trautschold, Tate, Torrubia, Toula, Uhlig, de Verneuil, Volborth, Valenciennes, S. P. Woodward, Waagen, Wahlenberg, Winchell, Whitefield, White, Worthen, Whiteheaves, Zittel, Zeiten, Zugmayer, Zeuschner, Zejszner, and many others whose names, with references to their works, will be found recorded in the Brachiopod Bibliography.[2]

[1] Lamarck's or Valenciennes' types of Brachiopoda are partly in the possession of the Museum of the Jardin des Plantes. Those that were in the collection of the late Baron Delessert have been added to the Museum of Geneva; they were described and figured by myself in the 'Annals and Mag. of Nat. Hist.,' 2nd series, vol. v, 1850.

[2] Among the largest and most important works on the Brachiopoda we must mention that by Joachim Barrande on the species collected by himself from the Silurian rocks of Bohemia. In that wonderful and monumental work the author figures 26 genera and 640 species of Brachiopoda, filling 153 quarto plates. No country or formation hitherto examined and of so limited an extent has afforded so large a number and such a variety of species. M. Barrande with princely generosity bequeathed the whole of his valuable collections to the Museum of Prague, where they can be consulted at any time.

The large and important collections assembled by M. E. de Verneuil during his many years of travel,

One of the most important advances made towards classification was the dividing of the Brachiopoda into two great groups, namely, that in which the intestine is provided with an anal aperture, and that in which it has none; but it must also be borne in mind

and comprising his figured types, were bequeathed by him to the Museum of the École des Mines of Paris, and could not have been better located.

Alcide d'Orbigny's collection, comprising the species described in his 'Paléontologie Française,' was purchased at his death by the administration of the Jardin des Plantes. France is exceedingly rich in species of Brachiopoda, but no general monograph of them has been hitherto published, especially of its many Devonian forms.

Most of our great British collections of fossils have found their way to the British Museum. William Smith's collection, Sowerby's types of the Mineral Conchology, Gilbertson's Carboniferous species, and many others, can be consulted there in the Geological Department, and I hope that some day my own collection of Brachiopoda may also obtain there a resting place. Murchison's Silurian types are at the Geological Society. Very many of those described in this Monograph form part of the admirably classed collection at the Museum of Practical Geology in Jermyn Street. Sedgwick's and M'Coy's types are in the Cambridge Museum.

The German Brachiopoda as well as those of Austria have received the attention of several distinguished palæontologists, and we must allude in particular to the many plates and figures published by Quenstedt in his 'Petrefactenkunde Deutschlands.' Prof. E. Suess's types of Austrian species form part of the Imperial Museum of Vienna. The species of Saxony have been carefully worked out by H. B. Geinitz.

Industrious Switzerland is publishing descriptions and figures of all its Brachiopoda in the 'Paléontologie Suisse.' The larger number have already been made known in that and other publications by Pictet, de Loriol, Ooster, Favre, Renevier, and others.

Belgian palæontologists have already described and figured a large number of their fossil Brachiopoda; Prof. L. de Koninck's great and admirable work on the 'Fossiles Carbonifères de la Belgique' is well known, but a monograph of the numerous Devonian forms remains still to be published.

The Brachiopoda of Russia have been to a great extent described and figured by M. de Verneuil, Count Keyserling, Pander, Rouiller, d'Eichwald, Fischer de Waldheim, Trautschold, Volborth, Kutorga, Möller, myself, and others. The forms that occur in that vast empire are numerous and peculiar.

The Swedish species have been described by Dalman, Hisinger, Nilsson, Angelin, Lindström, Linnarsson, and others. From the Upper-Silurian rocks of the small Island of Gothland alone nearly 150 species of Brachiopoda have been collected by Prof. Lindström. Dalman's and Angelin's types are carefully preserved in the Museum of Stockholm.

The Dutch species of Brachiopoda have been well studied and described by Bosquet and others. Those of Spain and Portugal have been likewise to some extent carefully investigated.

The Italian palæontologists are doing much to make known the species of their country, which is especially rich in Tertiary and Jurassic forms, so well described by Meneghini, Seguenza, Canavari, Parona, and many others.

The Brachiopoda that occur in Asia have to some extent been already carefully elaborated, especially so by Tchihatchef, de Koninck, Waagen, Stoliczka, and others. The large collection of the Salt-Range species is preserved in the Museum of Calcutta.

Not very many species of Brachiopoda have been found in Africa. Australian, Tasmanian, and New Zealand species have to some extent been already made known.

Nowhere, however, have the Brachiopoda received more attention than in America. The fine monographs published by J. Hall, Meek, Worthen, and many others, show how rich that vast continent is in species belonging to the Palæozoic period. The large collection made by Prof. Hall is now in the possession of the Museum at New York, where it is carefully attended to by Mr. Whitfield. Canada possesses many

that it is only in a very few recent genera and species that this investigation can be carried out, and that we can never know anything relating to the conditions of the intestine in the very large number of genera now extinct.

. In an interesting paper by Theodore Gill "On the Primary Divisions of the Brachiopoda"[1] it is stated that "these two groups have been repeatedly recognised, first by Prof. Owen, and then by Bronn, Huxley, and others." Owen, it is true, vigorously opposed the assertion that any forms had a cæcal intestine, but the groups he recognised were, as to their constituents, exactly equivalent to the *Tretenterata* and *Clistenterata*, although based only on the simple or the interlocking hinge and the relative proportions of the viscera and brachia. All other naturalists who have adopted the groups, however, have especially recognised the perforate or non-perforate condition of the intestinal tube in their diagnosis. Two groups have been thus adopted by the several naturalists, as follows:

I.

Lyopomata, Owen, 'Encycl. Brit.,' 8th ed., vol. xv, p. 301, 1858.

"Shell valves inarticulated, and, save in the annectant family *Craniadæ*, subcalcified; viscera occupying one half, brachia the other half, of the shell-cavity" (l.c., p. 339).

Pleuropygea, seu *Ecardines*, Bronn, 'Klass. u. Ordn-Thierreichs,' p. 301, 1862.

"Nahrungskanal (in den fossilen Sippen nur vermuthungsweise) lang, gewunden, durch einen After (rechterseits?) ausmündend," &c. (l. c., p. 301).

Inarticulata, Huxley, 'Int. Class. An.,' p. 116, 1869.

"The intestine terminates in an anus on one side of the body' (l. c., p. 116).

Lyopomata, Gill, 'Arr. Fam. Moll.,' p. 26, 1871. Dall, 'Am. Journ. Conch,' vol. vii, p. 71, 1871.

Tretenterata, King, 'Ann. and Mag. Nat. Hist.' (4), vol. xii, p. 15, 1873.

II.

Arthropomata, Owen, 'Encycl. Brit.' 8th ed., vol. xv, p. 336, 1858.

"Shell-valves articulated, calcareous; viscera occupying one third, brachia two thirds of the shell-cavity (l. c., p. 336).

Apygea, seu *Testicardines*, Bronn, 'Klass. u. Ord. Thierreichs,' p. 301, 1862.

"Nahrungskanal (bei den ganz fossilien Familien nur vermuthungsweise) mit einfachem abwärts gebogenem blind endigendem Darm-Anhange (Afterlose), &c." (l. c., p. 301)."

species of Brachiopoda, and which may be seen in the Museum at Ottawa. A series of very interesting Brazilian Carboniferous species have been described by Prof. Derby, and is now in the museum at Rio de Janeiro.

Klipstein's valuable collection of the St. Cassian Brachiopoda has been purchased by the British Museum.

[1] 'Annals and Mag. of Nat. Hist.,' 4th ser., vol. xii, p. 202, September, 1873.

Articulata, Huxley, 'Int. Class. An.,' p. 116, 1869.

"The intestine ends in a blind sac" (l. c., p. 116).

Arthropomata, Gill, 'Arr. Fam. Moll.,' p. 25, 1871. Dall, 'Am. Journ. Conch., vol. vii, p. 60, 1871.

Clistenterata, King, 'Ann. and Mag. of Nat.' (4), vol. xii, p. 15, 1873.

Gill ends by suggesting that, if we follow the rules of priority, Owen's names should be adopted; and that Bronn's, based on intestinal characters, might well be taken if Owen's were superseded; but I have made use of those proposed by Prof. King, believing them to be more appropriate.

In the General Introduction to this work I detailed what had been done up to 1853, with respect to the classification of the various families and genera constituting the class; and, although a very great advance has been effected in our knowledge during the thirty years since that time, it is not yet possible to offer an entirely satisfactory or permanent classification. This is chiefly due to the large number of so-termed genera that have been proposed without a sufficiently critical comparison with those already in use, so that much confusion has occasionally ensued; and it is not easy to deal satisfactorily with upwards of two hundred so-termed genera and more than five or six thousand species, named varieties, and dubious synonyms.

Any scheme of classification must therefore be to a certain extent considered as provisional, the difficulty of arriving at a completely satisfactory arrangement of the Brachiopoda being far greater than those not initiated in the subject can possibly be aware of. It is most desirable to seek simplicity as far as the subject will permit, for the Brachiopoda, as will be shown in the sequel, have played a very important part in the great life-system of our globe from nearly its first dawn up to the present time.

A tendency has unfortunately been manifested during the last few years to elevate into generic importance characters that are, I fear, of only secondary or specific value, and thus increase the number of so-termed genera to an unnecessary extent.

As already stated, it will be necessary to admit the two great divisions *Lyopomata* or *Tretenterata*, and *Arthropomata* or *Clistenterata*, into any scheme of classification.

Dr. Waagen observes at page 447 of his work on the Carboniferous Brachiopoda of the Salt Range ('Palæontologia Indica,' 1883), that "During the progress of the investigation bearing upon the description of the Brachiopoda of the Salt Range it has become absolutely necessary to create some larger subdivisions of the Brachiopoda, as the simple divisions into *Arthropomata* and *Lyopomata* appear to be quite insufficient to bring out clearly the relations of the different groups. I therefore propose to distinguish three sub-orders of the *Arthropomata*, for which I wish to introduce the following designations:

"i. Sub-Order *Kampylopegmata*, sive *Terebratulacea*, including the families *Terebratulidæ*, *Thecideidæ*, *Stringocephalidæ*, and *Rhynchonellidæ*. ii. Sub-Order *Helicopegmata*, sive *Spiriferacea*, comprising the families *Atrypidæ*, *Nucleospiridæ*, *Athyridæ*, and *Spiri-*

feridæ. iii. Sub-Order *Aphaneropegmata*, sive *Productacea*, comprising the families *Strophomenidæ* and *Productidæ*."

The following Table comprises all that we know for certain, as well as much of what is probable, about the relationships and ranges of the fossil Brachiopods, arranged as families, sub-families, and genera, under the two great groups or orders (see pp. 351 and 353).

LYOPOMATA, Owen = TRETENTERATA, King.[1]

FAMILIES and GENERA.	Palæozoic.					Mesozoic.				Cainozoic.	
	Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Rhætic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
Lingula, *Bruguière*, 1792	?										
Lingulella, *Salter*, 1866	—										
1. *Family* LINGULIDÆ, *Gray*, 1838. ? Lingulepis, *Hall*, 1863	—										
Glottidia, *Dall*, 1870	...	...	...	...	...	...	...	...	...	?	—
? Glossina, *Phillips*, 1848		—									
Dignomia, *Hall*, 1871	...		?	—							
? Lingulops, *Hall*, 1871	...										
Obolus, *Eichwald*, 1829	...										
Obolella, *Billings*, 1861											
2. *Family* OBOLIDÆ, *King*, 1846. Monobolina, *Salter*, 1865	—										
? Helmersenia, *Pander*, 1861	...										
? Schmidtia, *Volborth*, 1869	...										
? Keyserlingia, *Pander*, 1861	...										
Acretis, *Volborth*, 1869	...										
Discina, *Lamarck*, 1819											
Discinisca, *Dall*, 1871	...										
3. *Family* DISCINIDÆ, *Gray*, 1840. Paterula, *Barrande*, 1879	...										
Orbiculoidea, *d'Orbigny*, 1847	...										
Trematis, *Sharpe*, 1847	...										
Acrothele, *Linnarsson*, 1875	...										
Schizocrania, *Hall*, 1875	...										
Crania, *Retzius*, 1781	...										
? Pseudocrania, *M'Coy*, 1851	...										
4. *Family* CRANIDÆ, *Forbes*, 1838. Craniscus, *Dall*, 1871	...	...	...	...	...	...	...	—			
Pholidops, *Hall*, 1860	...	—									
Ancistrocrania, *Dall*, 1877	...	...	...	...	...	...	...	...	—		
Siphonotreta, *De Verneuil*, 1845	...										
5. *Family* SIPHONOTRETIDÆ, *Kutorga*, 1848. Acrotreta, *Kutorga*, 1848		—									
Volborthia, *Möller*, 1873	...										
Kutorgina, *Billings*, 1861	...										
Trimerella, *Billings*, 1862	...										
6. *Family* TRIMERELLIDÆ, *Dav. & King*. Monomerella, *Billings*, 1871	...										
Rhynobolus, *Hall*, 1871	...										
Dinobolus, *Hall*, 1871	...										

[1] This arrangement of the Lyopomata or Tretenterata agrees mainly with the one proposed by Dall in his 'Index to the Subdivisions of the Brachiopoda,' p. 80; Washington, 1877. See likewise Zittel's 'Handbuch der Palaeontologie,' 1880. In this Table I have followed Dall and Zittel's plan in the arrangement of the genera, instead of the successional stratigraphical plan adopted in my article "What is a Brachiopod?" published in the 'Geological Magazine' for June, 1877, dec. 2, vol. iv. Both ways have their advantages.

I have included in the *Lingulidæ* the genera *Lingula*, *Lingulella*, *Glottidia*, *Glossina*, *Dignomia*; *Lingulops* is with some uncertainty placed among the *Lingulidæ* (see the paper by King and myself "On the *Trimerellidæ*" ('Quart. Journ. Geol. Soc.,' p. 167, 1874). The characters made known evidently relate it both to the *Trimerellidæ* and *Lingulidæ*; but while thus allied, we felt undecided as to the family it should be placed in. Hall has proposed a genus *Dignomia* for a *Lingula* having a longitudinal septum in both valves, which occurs in the Lower Silurian and Devonian ('Twenty-third Report on the State Cabinet for 1871.') Phillips has proposed the genus *Glossina* for such shells as *Lingula crumena*, *L. attenuata*, and some others, but the differential characters have not been sufficiently determined to warrant its admission, and he gives no diagnosis (see 'Mem. Geol. Survey of Great Britain,' vol. ii, part i, p. 370, 1848).

In the second family (*Obolidæ*) Dall places *Spondilobolus*, M'Coy; *Monobolina*, Salter; *Kutorgina*, Billings; *Obolella*, Billings; *Aulonotreta*, Kutorga (pars); *Helmersenia*, Pander; and *Keyserlingia*, Pander. It is an assemblage of widely different things, and as to the correct position of some of them I still feel uncertain.

In 1830 Pander proposed a genus *Ungula* ('Beitr. Geogn. Russ. Reiches,' pp. 55-7, type *U. convexa*, Pander = *Obolus apollinis*, Eichwald, 1829 ('Zool. Specialis,' i, p. 274, tab. iv, fig. 5). As Eichwald's generic name of *Obolus* was published one year previous to that of Pander it will require to be retained in preference to its synonym *Ungula*. In 1848 Bronn proposed a genus *Lingulites*, but it cannot be adopted.

Dall in the 'American Journal of Conchology,' vol. vii, part 2, p 74, 1881, and in the 'Proceedings of the Phil. Acad. Nat. Sciences,' p. 200, July, 1873, divided the genus *Discina* into *Discina* proper, Lamarck, 'Hist. Nat. des Animaux sans Vertèbres,' vol. vi, p. 256, 1819, type *Discina ostræoides* = *D. striata*; and he proposed another genus or sub-genus, *Discinisca*, for such shells as *D. lamellosa*, Brod. It is, however, difficult in many cases among the fossil forms to feel certain to which of these groups such and such a shell should be referred, and to define correctly their respective stratigraphical ranges from the Cambrian up to the recent time.

I am uncertain with respect to the generic value of Hall's genus *Schizocrania* ('Pal. Ohio,' vol. ii, p. 71, 1875). Dall in his "Index to the Class Brachiopoda," p. 61, places it among the *Discinidæ* and says, "The lower or flat valve is deeply notched on the posterior side of the centre, the notch extending from a point more or less distant from the centre of the valve to the posterior margin, where the sides of the slit are widely and distinctly separated, type *S. filosa*." I am uncertain whether it is a Brachiopod at all. What is figured as the ventral valve seems referable rather to a species of *Discinocaris*.

Although five genera have been classed in the Family *Craniidæ*, I am not yet quite satisfied with respect to the generic importance of *Pseudocrania*, M'Coy; *Craniopora*, Schauroth; and *Ancistrocrania*, Dall. They are admitted by Dall in his table of distribution, and may prove to be good genera.

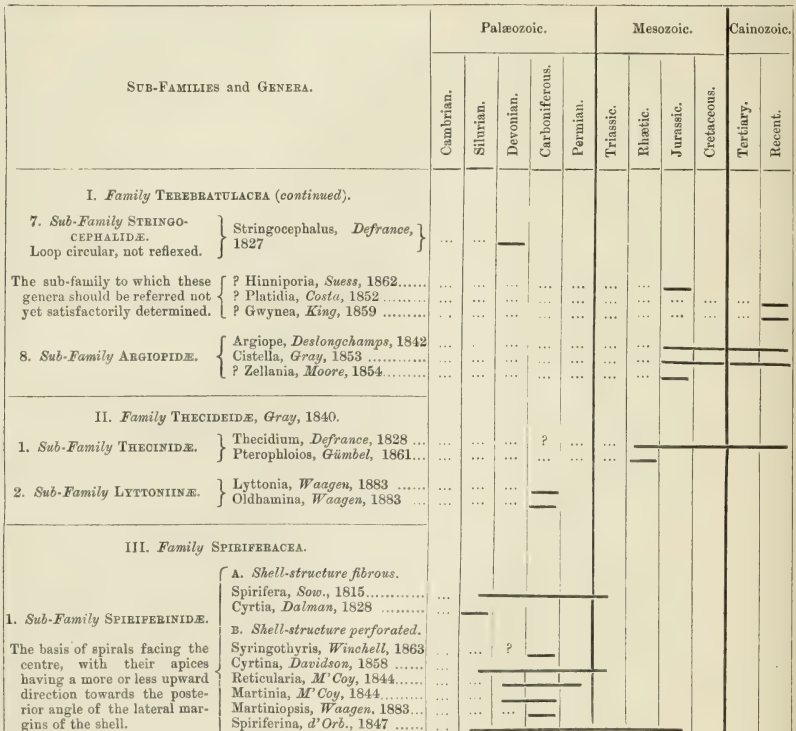
Some uncertainty may prevail as to *Volborthia*, Möller, and *Kutorgina*, Möller, being

correctly classed in the *Siphonotretidæ*. Dall admits the genus *Mesotreta*, Kutorga, 'Verh. Kais. Min. Ges. St.-Petersburg,' 1847, type *M.* (*Siphonotreta*) *tentorium*, Kut., as a distinct genus among the *Siphonotretidæ*.

The *Trimerellidæ* are a well-characterised family (see Dav. and King "On the Trimerellidæ, a Palæozoic Family of Brachiopoda," 'Quarterly Journal of the Geological Society of London,' vol. xxx, page 124, &c., 1874). The Trimerellids we observed to be closely related to the Lingulids, but distinct as a family. In that paper we described seven species of *Trimerella*, four of *Monomerella*, and seven of *Dinobolus*, and alluded to all the localities where these fossils had been discovered. Since then, however, another species of *Monomerella* has been found by Prof. F. Schmidt at Werden in Russia, and a small form of *Trimerella* at Larsholm in the same empire. Mr. Whiteaves has also described a new fine *Dinobolus*, *D. ovatus*, from Durham, Ontario, in Canada.

ARTHROPOMATA, Owen = CLISTENTERATA, King.

SUB-FAMILIES and GENERA.	Palæozoic.					Mesozoic.				Cainozoic.	
	Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Rhætic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
I. *Family* TEREBRATULACEA.											
1. *Sub-Family* TEREBRATULIDÆ. Loop simple, varying in length, attached to the hinge-plate of dorsal valve.											
Dielasma, *King*, 1859	...	...									
Terebratula, *Klein*, 1753	...	...	...	...	...	...					
Terebratulina, *d'Orbigny*, 1847	...	...	...	...	...	...	...				
? Hemiptychina, *Waagen*, 1883	...	...	...								
Loenothysis, *Douvillé*, 1880	...	...	...	...	...						
Waldheimia, *King*, 1850	...										
Terebrirostra, *d'Orb.*, 1847	...	...	...	...	...						
Meganthyris, *Suess*, 1856	...	...									
2. *Sub-Family* CENTRONELLINÆ. Loop long, composed of two ribbon-shaped lamellæ with crura; the lamellæ uniting at their anterior extremities, and a more or less developed vertical lamella rises between.											
Centronella, *Billings*, 1859	...										
Rensselæria, *Hall*, 1859	...										
? Leptocœlia, *Hall*, 1857	...										
3. *Sub-Family* TEREBRATELLIDÆ. Loop twice attached, to hinge-plate and to a median septum.											
Terebratella, *d'Orbigny*, 1847	...	...	...	...	...	...	...				
? Magasella, *Dall*, 1870	...	...	...	...	...	...	...	...	...	?	
Trigonosemus, *Koenig*, 1825	...	...	...	...	...	...	...	...			
4. *Sub-Family* MEGERLIDÆ. Loop three times attached; lateral lobes closed.											
Megerlia, *King*, 1850	...	...	...	...	...	...	...				
Kingina, *Dav.*, 1852	...	...	...	...	...	...	...	...			
Laqueus, *Dall*, 1870	...	...	...	...	...	...	...	...	...	...	
5. *Sub-Family* MAGASIDÆ. An anchor-shaped lamella attached to a mesial septum.											
Magas, *Sow.*, 1816	...	...	...	...	...	...	...	...			
Bouchardia, *Dav.*, 1849	...	...	...	...	...	...	...	...	...	...	
Rhynchora, *Dalman*, 1828	...	...	...	...	...	...	...	...			
? Mannia, *Dewalque*, 1874	...	...	...	...	...	...	...	...	...		
6. *Sub-Family* KRAUSSIDÆ. No loop; interior of dorsal valve furnished with a forked process rising nearly centrically from the bottom.											
Kraussina, *Dav.*, 1859	...	...	...	...	...	...	...	...	...	...	



The Sub-Family in which *Thecospira* and *Davidsonia* should be placed is not quite certain.

Sub-Families and Genera.	Palæozoic.					Mesozoic.				Cainozoic.	
	Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Rhætic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
III. *Family* Spiriferacea (*continued*).											
5. *Sub-family* Anazygidæ. — Anazyga, *Dav.*, 1882	...	—									
5. *Sub-family* Anazygidæ. — Dayia, *Dav.*, 1882	...	—									
5. *Sub-family* Anazygidæ. — Hindella, *Dav.*, 1882	...	—									
6. *Sub-family* Koninckinidæ. — Anoplotheca, *Sandberger*, 1857	...	...	—								
6. *Sub-family* Koninckinidæ. — Koninckina, *Suess*, 1853	...	...	...	...	...	—					
6. *Sub-family* Koninckinidæ. — Koninckella, *Munier-Chalmas*, 1880	...	...	...	...	...	...	...	—			
? Davidsonia, *Bouchard*, 1849	...	...	—								
IV. *Family* Rhynchonellinidæ.											
1. *Sub-family* Rhynchonellinæ. — Rhynchonella, *Fischer*, 1809	...										
D'Orbigny has proposed a genus *Acanthothyris* for *R. spinosa*; Bayle a genus *Uncinulus* for such shells as *Rh. sub-Wilsoni*; but I question the necessity of removing them from the genus *Rhynchonella*. — ? Terebratuloidea, *Waagen*, 1883	...	...	—	—							
D'Orbigny has proposed a genus *Acanthothyris* for *R. spinosa*; Bayle a genus *Uncinulus* for such shells as *Rh. sub-Wilsoni*; but I question the necessity of removing them from the genus *Rhynchonella*. — Rhynchopora, *King*, 1856	...	...	...	—	—						
D'Orbigny has proposed a genus *Acanthothyris* for *R. spinosa*; Bayle a genus *Uncinulus* for such shells as *Rh. sub-Wilsoni*; but I question the necessity of removing them from the genus *Rhynchonella*. — Eatonia, *Hall*, 1857	...	—	—								
D'Orbigny has proposed a genus *Acanthothyris* for *R. spinosa*; Bayle a genus *Uncinulus* for such shells as *Rh. sub-Wilsoni*; but I question the necessity of removing them from the genus *Rhynchonella*. — Dimerella, *Zittel*, 1870	...	...	...	...	...	—					
D'Orbigny has proposed a genus *Acanthothyris* for *R. spinosa*; Bayle a genus *Uncinulus* for such shells as *Rh. sub-Wilsoni*; but I question the necessity of removing them from the genus *Rhynchonella*. — Atretia, *Jeffreys*, 1876	...	...	...	...	...	...	...	...	...	...	—
2. *Sub-family* Camarophorinæ. — Camarophoria, *King*, 1846	...	...	—	—	—						
3. *Sub-family* Pentamerinæ. — Pentamerus, *Sow.*, 1813	...	—	—								
3. *Sub-family* Pentamerinæ. — Pentamerella, *Hall*, 1839	...	..	—								
3. *Sub-family* Pentamerinæ. — Stricklandinia, *Billings*, 1863	...	—									
3. *Sub-family* Pentamerinæ. — ? Amphigenia, *Hall*, 1869	...	...	—								
3. *Sub-family* Pentamerinæ. — ? Camarella, *Billings*, 1859	...	—									
Generic position and family still undetermined. — ? Leiorhynchus, *Hall*, 1860	...	...	—								
Generic position and family still undetermined. — ? Eichwaldia, *Billings*, 1858 [1]	...	—									

[1] When alluding to *Eichwaldia Capewelli* at pp. 140 and 141 of my 'Silurian Supplement' I inadvertently omitted to refer to its remarkable shell-structure described and figured by Prof. Lindström at p. 25 of his and Angelin's 'Fragmenta Silurica,' 1880. Prof. Lindström remarks that the shell of the ventral valve consists of two layers, of which the innermost only occupies the bare space at the beak; and that the external layer is perforated by minute tubules running obliquely inwards and downwards, and continued as little furrows, which ornament the surface of the shell in a quincuncial manner. Also that other (horizontal) tubules perforate the test from the inferior part; and that the beak of the ventral valve is always bare as if by the removal of the external layer. Prof. Lindström accompanies his description with several carefully drawn illustrations.

Since the publication of Prof. Lindström's description Mr. John Young has also carefully investigated the shell-structure of *Eichwaldia Capewelli*, being at the time unacquainted with what Prof. Lindström had done in the matter. He writes me, "My examination of this beautiful and interesting shell has led me to recognise three distinct layers in its structure: first, the outer hexagonal layer, in which the walls are thin at the surface but thicker at their base, and cover a layer of minute polygonal cells that are bounded by thin walls. These polygonal cells form the second layer inwards, and are not seen on the surface except when the outer cell-layer has been eroded or not well developed. A certain number of these cells rise above the bottom of the larger cells, and enter the outer cell-walls. In eroded and polished

Sub-Families and Genera.		Palæozoic.					Mesozoic.				Cainozoic.	
		Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic	Rhætic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
Generic position and family still undetermined.	? Triplesia, *Hall*, 1859	...	—									
	? Streptis, *Dav.*, 1881 [1]	...	—									
V. *Family* Porambonitidæ, *Dav.*, 1853.												
Zittel places Meek's genus *Syntrielasma* with the *Porambonitidæ*. Whether *Porambonites* should constitute a distinct family has still to be determined.	Porambonites, *Pander*, 1830...	...	—									
VI. *Family* Orthisidæ, *d'Orbigny*.												
In this family several other so-termed genera have been included. Bayle adopts Schlotheim's generic name *Hysterolithus* for such shells as *O. resupinata*. A genus *Discœlosia* was proposed by King for *Orthis biloba* and *Platistrophia* for *O. biforata*.	Orthis, *Dalman*, 1828	—	—	—	—	?						
	Enteletes, *Fischer*, 1837 ..... = Syntrielasma, *Meek*.	...	...	...	—							
	? Schizophoria, *King*, 1850 ...	...	...		—							
	Skenidium, *Hall*, 1860.....	...	—									

specimens as many as from six to eight of the smaller cells may be seen in the wall around each larger hexagonal cell, one being generally situated in each of the angles, and sometimes one between; but, as already stated, they do not appear to reach the outer surface of the shell in perfect or unworn specimens. The third or innermost layer of the shell is the dense portion that is perforated by minute circular tubes. These tubes are small, as those in the shell-structure of the Carboniferous *Dielasma* (*Terebratula*) *hastata*, but they are only about one third as numerous as seen in that shell. They agree in character with that seen in many other of the Brachiopoda, but the outer shell-layer of *E. Capewelli* is so unlike what is known to exist in this group that one is not surprised to learn that it has been suspected to be of Polyzoal origin, and the resemblance of the cell arrangement to that seen in some forms of *Monticulipora* is further increased by finding that the outer cell-walls enclose a series of small polygonal cells, as is common in some members of this group. In a vertical section through both valves and from fragments picked up from the shale I find that the outer celluliform layer is just about equal in thickness to that of the dense inner layer of the shell." Mr. Young believes that the bare part of the beak, which I have already described in my Monograph, was probably attached to marine objects and afterwards broken away from its attachment, for besides the rough ragged edges of the shell layer there is no finish to the edges of the cells. Mr. Young remarks likewise that Prof. Lindström notices only two layers, but that there exists a third or thin outer one that forms the external hexagonal cells, and which when present and perfect conceals the inner small polygonal cells.

[1] Much uncertainty still prevails with respect to the family into which the genus (?) *Streptis* should be classed. Its interior characters are difficult to determine, and well-preserved interiors of the valves and internal casts have still to be discovered. At my request Mr. John Young ground down and made sections from a number of promising specimens I had obtained from Mr. Maw's washings of Wenlock Shale, but he could discover in them not a trace of a loop or of spirally-coiled appendages.

Sub-Families and Genera.	Palæozoic.					Mesozoic.				Cainozoic.	
	Cambrian.	Silurian.	Devonian.	Carboniferous.	Permian.	Triassic.	Rhætic.	Jurassic.	Cretaceous.	Tertiary.	Recent.
VII. *Family* Strophomenidæ, *King*, 1846.											
Into this family several so-termed genera have been placed, but which will require further examination before they can be all finally admitted.											
Orthisina, *d'Orb.*, 1847	...	—									
Meekella, *White*, 1870	...	...	...	—							
Streptorhynchus, *King*, 1850	...	...	...	...	—						
Derbyia, *Waagen*, 1884	...	...	—	—	—						
Strophomena, *Raf.*, 1820	...	—	—	—							
Orthotetes, *Fischer*, 1829	...	—	—	—							
Strophodonta, *Hall*, 1850	...	...	—								
Tropidoleptus, *Hall*, 1857	...	...	—								
Leptæna, *Dalman*, 1828	...	—	—	—	...	...	...	?			
VIII. *Family* Productidæ, *King*, 1846.											
This is a well characterised family.											
Productus, *Sow.*, 1812	...	...	—	—	—						
Productella, *Hall*, 1867	...	...	—	—							
Strophalosia, *King*, 1844	...	...	—	—	—						
Aulosteges, *Helmersen*, 1847	...	...	...	...	—						
Chonetes, *Fischer*, 1837	...				—						
Aulacorhynchus, *Dittmar*, 1871	...	...	—	—	—						

Family—TEREBRATULIDÆ.

At p. 329 of his work 'On the Carboniferous Fossils of the Salt Range,' Dr. Waagen says that "In the systematic arrangement of the Mollusca in general, there has in recent times prevailed a tendency to restrict the large generic groups, resolving them into a number of smaller and more sharply defined genera, which should at the same time serve to bring out more clearly the changes the Mollusca have undergone in time, so as to unite under one generic heading those forms which are not very far separated from each other in time. There is no obvious reason why the *Brachiopoda* should be excluded from the tendency now prevailing among men of science in relation to the Mollusca proper, the less so as the shells of the Brachiopoda require even sharper distinction than do the shells of the Mollusca. Any one who has ever had to determine the shells of the Brachiopoda must know that in certain groups, for instance, in the group of the *biplicate Terebratulæ*, it is nearly impossible to determine a species without knowing the formation from which the specimens came; and, even if this latter fact be known, it requires the utmost carefulness and the observation of the most minute characters to distinguish the different species, and arrive at a satisfactory specific determination of these shells."

What Dr. Waagen states with respect to the *biplicate Terebratulæ* is quite correct, and this difficulty is equally felt in connection with species belonging to many of the other groups. It is quite true likewise that it has been found necessary to divide the large family Terebratulidæ into a certain number of groups or sub-families, each group being composed in the present state of our information of one or more genera; but palæontologists are as yet far from having agreed in every case as to the genera that should constitute each sub-family.

M. H. Douvillé, Prof. Zittel,[1] and some others would, I fear, feel disposed to admit a larger number of sub-families and genera than I might consider desirable; but as this is a matter of opinion, I do not wish to press my own personal views in opposition to theirs, which may perhaps after all be the most correct.

For instance, M. H. Douvillé, in his interesting memoir, 'Sur quelques genres de Brachiopodes (*Terebratulidæ* et *Waldheimiidæ*),'[2] proposes to admit the following eight genera (viz. *Terebratulina, Terebratula, Liothyris, Dictyothyris, Glossothyris, Pygope, Dielasma,* and *Cœnothyris*) into his family *Terebratulidæ*. On these I would make some remarks bearing upon their loops.

1*st Genus*.—Terebratulina, d'Orb., 1847; type *T. caput-serpentis*, Linné.

In this genus the loop is rendered annular by the union of the oral processes.

2*nd Genus*.—Terebratula, Llwyd (1699) and Klein, 1753 ('Tentamen Methodi Ostracologicæ,' p. 171, pl. 11, fig. 74), type *Anomia Terebatula*, Linné.

Loop short, rarely attaining a third of the length of the dorsal valve, and formed of two short branches connected anteriorly by a more or less arched and not reflected lamella. This lamella varies a good deal in size in different species. In *T. uva, T. vitrea, T. carnea, T. Cubensis, T. subquadrata,* and in some Tertiary species, it is small, a little larger but similar in character in *Terebratula biplicata, T. sub-sella, T. ampulla, T. grandis,* &c.

For the first lot of above-named species M. Douvillé proposes the generic name of *Liothyris*, for the second that of *Terebratula*, Klein; but, as they all pass one into the other and possess the same general characters, the dividing them into two genera seems to me perfectly unnecessary and only complicates the nomenclature for no serviceable purpose.

The first notice I can discover of the word *Terebratula* is in the first edition of Llwyd's book, 'Lithophylacii Britannici Ichnographia,' p. 40, 1699, where he says:—"827. *Terebratula* flabelliformis nigra, gibbosa major. In lapicidinis Witneiensibus invenimus, sed rarissimè. *Est autem Terebratula conchites lævis Trigonellæ congener; à perforato* (*utplurimùm*) *rostro, sic dicta.*" Llwyd in his plates 10 and 11 gives figures of

[1] 'Handbuch der Palaeontologie,' pp. 643 to 722, 1880.

[2] 'Bull. Soc. géol. de France,' 3rd ser., vol. vii, p. 251, 1879.

shells we now term *Waldheimia ornithocephala* (fig. 871), *Waldheimia digona* (fig. 873), and *Terebratula maxillata* (figs. 829 and 830). *Tereb. maxillata* has a short, slightly reflected loop, and would therefore differ to some extent from those species which we refer to *Terebratula* of Klein.

In 1753 Klein, at p. 171 of his work above referred to, wrote:

"Genus I.—*Terebratula*. § 426. Terebratulas, *Luidiano* titulo, vocamus *Dichonchas* anomalas, rostro perterebrato, vid. *Nomencl. Litholog. Promotum* hoc titulo.

§ 427. Species: 1. Simplex; et rugosa *Fab. Columnæ de Purp.*, Cap. xii, § 3, page 32, figuræ oblongæ; margine æquali. Icon exstat in Tab. Nostr. xi, no. 74." Klein reproduces Colonna's biplicated form; also his plicated one, which last is a *Rhynchonella*.

Douvillé, in his paper already referred to, says: "Ce genre (*Terebratula*) a été fondi par Klein pour les *Concha anomia* de Fabio Colonna. Klein reproduit une des figures de cet auteur représentant une *Terebratula* fossile du groupe des *biplicatæ* très voisine de la *T. ampulla* du Pliocene d'Italie. C'est à cette figure, à laquelle Linné a appliqué le nom *spécifique* de *Terebratula* que nous prenons pour le type du genre."

Linné's *Anomia terebratula* first appeared, as far as I am aware of, as a fossil, in the tenth edition of the 'Systema Naturæ,' p. 703, Holmiæ, 1758, as follows:

"*Anomia Terebratula* 201. A. testa obovata lævi convexa: valvula altera triplicata, altera biplicata.

"Column. *purp.*, 22, fig. 1.

"List. *angl.*, 240, t. 8, fig. 46.

"Klein, *ostr.*, t. 11, fig. 74.

"Habitat fossilis. Natis alterius testæ prominens pertusa est: extus plicae duae."

Linné's reference to Lister cannot be correct, but as he also points to Colonna's figure and that of Klein we know what the shell was he had in view.[1]

We really do not know from what formation the type of Colonna's and Klein's *Terebratula* was derived.

3rd Genus.—Liothyris, Douvillé; type *Ter. vitrea*, Born sp.

For the reasons already stated I would place this so-called genus under the synonym of *Terebratula*. The short loop and arched lamella agreeing in character with that seen in Klein's genus.

4th Genus.—Dictyothyris, Douvillé; type *T. coarctata*, Parkinson.

M. Douvillé informs us that the loop in his type does not differ much from that observable in Klein's *Terebratula*, but it seems to me that there exists more difference in the loop of this species, *T. maxillata*, *T. intermedia*, and some others than there does exist between *Terebratula* and *Liothyris*.

[1] See also 'Ipsa Linnæi Conchylia,' by S. Hanley, p. 132, 1880.

In the species above named the connecting lamella is proportionally larger and somewhat reflected.

5*th Genus.*—Glossothyris, Douvillé; type *T. nucleata*, Schlotheim.

This so-termed genus seems to be based upon very deceptive exterior characters. Its loop is short and similar to that of *Terebratula*. In external shape *Terebratula nucleata* much resembles the recent *Terebratula Wyvillei*, Dav. External shape cannot be taken into consideration, otherwise we would have to make as many genera as there are species. *Glossothyris* is, according to my view, a synonym of *Terebratula*.

6*th Genus.*—Pygope, Link, 1830; type *T. triquetra*, Parkinson (*Anomia diphya*, Colonna).

Douvillé commences by informing us that the loop is not completely known, but that it is short, and that it does not differ materially from that of his genus *Glossothyris*. In 1869, in the 'Quarterly Journal of the Geological Society,' I described and figured the loop of *Terebratula diphya*, and of this perhaps M. Douvillé was not aware at the time when he wrote his memoir.

7*th Genus.*—Dielasma, King; type *T. elongata*, Schlotheim.

Douvillé admits that the loop is the same as in *Terebratula*, Klein. In 1850, King erroneously placed *T. elongata* in Phillips's genus *Epithyris*, but removed it from that genus in 1859, proposing for its reception a genus, *Dielasma* ('Dublin Natural History Review,' vol. vi, p. 519, 1859), on account of the dorsal valve possessing dental plates.

Dr. Waagen, who warmly advocates the adoption of this genus, says that "the characters of *Dielasma* are very easy to be recognised. They consist in the general terebratuloid form of the shell; a short loop like in *Terebratula*, fastened near its origin to the bottom (hinge-plate) of the smaller or dorsal valve by two plates, which extend in a more or less oblique direction from the sockets for the reception of the cardinal teeth towards the middle line of the dorsal valve, forming sometimes a septum. The umbo of the smaller valve bears a distinct cardinal process. In the larger or ventral valve the cardinal teeth are supported by very strong dental plates. The existence of these dental plates, as well as the septal ones, can easily be made out by scraping off a little of the shell on the beak as well as in the umbonal region of the smaller valve; the plates will then soon appear as dark lines converging towards the termination of the beak as well as towards the apex of the smaller valve." According to the same author, the genus seems to commence in the Devonian period, and to continue through the Carboniferous and Permian formations; it is rare in the Trias, and in the upper region of this system, the Kössen beds, it is entirely replaced by *Rhætina*, Waagen, and *Zugmeyeria*, Waagen; so that in these beds no traces of *Dielasma* are any longer found. Also in the Jurassic and Cretaceous times the

genus is entirely absent. Dr. Waagen places in the genus *Dielasma*, *Terebratula sacculus*, Martin; and perhaps *T. sufflata*, Schl.; *T. ficus*, M'Coy; *T. virgoides*, M'Coy; *T. hastæformis*, de Kon.; *T. plica*, Kutorga; *T. Gillingensis*, Dav.; *T. elongata*, Schl., &c.;[1] and he does not fail to remark, at p. 338 of his work, that "There decidedly exist intermediate forms between all the above-mentioned species or sub-species or whatever we like to call them; and a perfect transition can be traced from one form to the other. It cannot be doubted, (and the standard of thorough study and excellent power of observations exhibited by all the works of Mr. Davidson is an absolute security for this), that the transitional forms really exist, and that all the fossils mentioned under the above names are all most intimately connected together; nevertheless, I must retain the opinion that these fossils have all to be considered as distinct species. Any one who has collected Brachiopods in large numbers in the field will have made the observation that in this class of Molluscs, more than in any other classes, transitional forms between different species occur, and that such transitional forms are chiefly numerous in certain groups, for instance, in the biplicate *Terebratulæ*, more than in others. That such transitional forms occur between species which are of different geological age is only natural, and depends upon the mode of development of the species; but also between contemporaneous species transitional forms exist. In this latter case, the distribution of the transitional forms is very unequal; in some localities many of them occur, in others they are only very sparingly represented, or even entirely absent. This mode of occurrence seems now to be in direct proportion to the number of specimens of each species which are found in each locality. In places where very great numbers of individuals of two species are heaped together, transitional forms are more numerous; in other localities, on the contrary, where two species occur, but not in great numbers, transitional forms are rare and even entirely absent. This seems to indicate a circumstance which has not up to the present been sufficiently taken heed of. In localities where two species in very great numbers were crowded, there seems to have been great possibility for the production of hybrids, whilst in other localities where the two were not so numerous few or no hybrids were produced, and thus in the cases of contemporaneous species the transitional forms might for the greater part be due to the hybridity. But the production of hybrids cannot establish identity of species. It can thus, I think, very well be sustained that, even if transitional forms exist, yet two fossils of different shapes might very well form different species, and thus we come back to the old axiom that every form that can be fixed and distinguished from others by description and figures, has to be considered as

[1] Dr. Waagen says, "M'Coy in his 'British Palæozoic Fossils' thought proper to apply the name *Seminula*, which he had formerly given to other shells, to species which form now the genus *Dielasma*; but, as in the original diagnosis of *Seminula*, only those shells were comprised which belong to the families *Rhynchonellidæ* and *Spiriferidæ*, it does not seem advisable to transfer the name now to shells belonging to the *Terebratulidæ*; thus, from this consideration also, the name *Dielasma* will have to stand. Bayle adopts the name *Seminula* for *T. hastata*, but from the above-given reasons the name will have to be erased."

constituting a species, though this must be understood "cum grano salis." I am therefore willing to retain the genus *Dielasma* of King.

8*th Genus.*—Cœnothyris's, Douvillé; type *T. vulgaris*, Schlotheim.

I am not sufficiently acquainted with the real nature of the loop of this species, as I have never seen it myself, but, judging from von H. C. Koschnisky's description and figures of its interior, the generic characters seem to be substantiated.[1]

Therefore out of the eight genera proposed by Douvillé, I would retain four only. *Terebratulina*, d'Orb.; *Terebratula*, Klein; *Dielasma*, King; and *Cœnothyris*, Douvillé; but in this matter I express my own views, but which others may reject.

In his work above quoted, Dr. Waagen proposes several more genera for the *Terebratulidæ:*

"Rhætina, Waagen, 1882. Type *T. gregaria*, Schafh; shell biplicate; loop short, fixed to the bottom of the valve by septal plates, which sometimes form a septum, sometimes not; ventral valve without dental plates; Rhætic."

Judging from the figure of the interior of the dorsal valve given by Waagen, the loop seems to be similar in shape and character to that of *Terebratula*.

"Zugmeyeria, Waagen, 1882. Shell biplicate; loop short; without septal plates. Strong dental plates in ventral valve. Type *Terebratula rhætica*, Zugmayer; Rhætic."

Judging from Herr Zugmayer's figures of the loop of *T. rhætica* (Über Rhätische Brachiopoden, pl. i, figs. 29—31, 1880), I feel disposed to leave this species in the genus *Terebratula*.

"Hemiptychina, Waagen, 1882. Surface of the shell smooth or irregularly folded in the frontal region; frontal line vaulted; loop short, like in *Terebratula;* with distinct septal plates, which very rarely unite to form a septum. Type *Terebratula Himalayensis*, Dav.

"Dielasmina, Waagen, 1882. Shell strongly but irregularly folded radially; internal arrangement as in *Dielasma*. Type *Diel. plicata*, Waagen."

Although I do not yet see my way to admitting all these genera, I have considered it but just and fair to the distinguished German palæontologist to reproduce his views upon this subject.

Dr. Waagen adds that only for one genus does the systematic position remain doubtful, this is *Hynniphoria*, Suess,[2] in which opinion I completely concur.

Dr. Waagen condenses his views relative to the *Terebratulidæ* in the following tabular form.

[1] "Beiträge zur Kenntniss von Terebratula vulgaris, Schlotheim" 'Zeitsch. deutsch. geol. Gesellschaft,' Jahrg., 1879.

[2] "Beitr. Paläont. Oesterr.," Franz von Hauer, Bd. i, Heft. 2, p, 44, t. v, figs. 4—8, 1858.

Loop short.					
Annular by the union of the oral processes. Neither dental nor septal plates.	Not annular: by the disunion of the oral processes.				
	Neither dental nor septal plates.	Only dental, and no septal plates.	Only septal, and no dental plates.	Septal and dental plates.	
Terebratulina, d'Orb.	*Terebratula*, Klein	*Zugmeyeria*, Waagen	*Rhætina*, Waagen	*Dielasma*, King *Cœnothyris*, Douvillé	*Biplicatæ.*
	(New Gen.?)	...	*Hemiptychina*, Waagen	*Dielasmina*, Waagen	*Fimbriatæ.*
	Pygope, Link	...	...	...	*Nucleatæ.*
	Dictyothyris, Douvillé	...	...	...	*Coarctatæ.*

Douvillé proposes likewise a family *Waldheimiidæ*, in which he comprises the following so-termed genera.

1. *Genus* Macandrevia, King, 1859; type *Ter. cranium*, Müller.
2. *Genus* Waldheimia, King, 1850; type *T. flavescens*, Lamarck.
3. *Genus* Neothyris, Douvillé, 1880; type *W. lenticularis*, Deshayes.
4. *Genus* Plesiothyris, Douvillé, 1880; type *Ter. Verneuili*, Deslongchamps.
5. *Genus* Zeilleria, Bayle, 1878; type *T. cornuta*, Sow.
6. *Genus* Eudesia, King, 1850; type *T. cardium*, Lamarck.
7. *Genus* Aulacothyris, Douvillé, 1880; type *T. resupinata*, Sow.

I cannot help considering these so-termed genera to be very nearly connected, and to be synonyms of King's excellent genus *Waldheimia*. They have all similar loops. *Macandrevia*, King, type *M. cranium*, has, however, been adopted by several palæontologists, and I do not know whether I am justified in rejecting it. Most, if not all, of Douvillé's genera in his family *Waldheimiidæ* seem to have been established on external differences, and if such were to be adopted very many more so-termed genera would have to be admitted. I question likewise the propriety or necessity of establishing a second family, or even sub-family, *Waldheimiidæ*, for M. Douvillé includes in his first family *Terebratulidæ* forms quite and even more distinct from each other than is *Terebratula* from *Waldheimia*. They have all in common a loop simply attached to the hinge-plate, which loop is shortest in *Terebratula*, longer in *Cœnothyris*, and longest in *Waldheimia* and Douvillé's other so-termed genera of *Waldheimiidæ*. Consequently I would leave *Waldheimia* in the sub-family *Terebratulidæ*.

A sub-family, Centronellinæ, proposed by Waagen in 1883, would, as far as we know at present, probably comprise the following genera:—

Centronella, Billings, 'Canadian Naturalist,' vol. iv, p. 131, 1859, type *C.* (*Rh.*) *glansfagea*, Hall.

Notothyris, Waagen, 'Palæontologia Indica, Salt-Range Fossils,' p. 375, 1883, type *Notothyris* (*Ter.*) *subvesicularis*, Dav., sp.

Leptocœlia, Hall, 1859, 'Twelfth Regents' Report,' type *L. flabellites*, Hall. (Not 1857.)

Rensselæria, Hall, 'Tenth Regents' Report,' 1857, type *R.* (*Ter.*) *ovoides*, Eaton, sp.

Many efforts have been made by Mr. Billings, Prof. Hall, the Rev. Norman Glass, myself, and some others to define the internal characters of this difficult and interesting group of genera, but I am not certain that they have been as yet completely developed.

In a very interesting and instructive paper, accompanied by two well-drawn plates, entitled "Note sur *Terebratula* (*Centronella*) *Guerangeri*, De Verneuil sp.," 'Bulletin de la Société d'Études Scientifiques d'Angers, 1883,' M. Œhlert shows the close affinities which seem to exist between *Centronella*, *Leptocœlia*, and *Rensselæria*, and adds some important details in connection with the genera *Centronella*.

At p. 14 of my 'Devonian Supplement' the Rev. Norman Glass and myself have stated all we had been able to make out with respect to Billings' genus *Centronella*. M. Œhlert's subsequent researches in connection with *Centronella Guerangeri* enable him to offer the following revised diagnosis:

"Coquille térébratuliforme, généralement lisse, parfois costulée. Test poncturé. Valve ventrale de beaucoup plus convexe, légèrement carénée le long de la ligne médiane. Crochet saillant. Foramen ovalaire séparé de la ligne cardinale par un deltidium de deux pieces. Valve ventrale montrant deux fortes dents, soutenues par deux plaques dentaires. Valve dorsale convexe vers le crochet et déprimée vers le bord palleal. Système apophysaire occupant environ les deux tiers de la longeur de la valve: il est constitué par deux crura munis de deux pointes crurales, auxquels font suite deux bandelettes rubaniformes qui après c'étre écartées légèrement l'une de l'autre se rejoignent à la partie antérieure en formant un angle aigu, au milieu duquel s'éléve, du côté ventral, une lamelle verticale plus ou moins développée et dirigée vers le crochet. Les lamelles récurrentes de *Centronella* parraissent correspondre à l'appareil ascendant des *Waldheimia* ayant subi un arrêt de développement. L'appareil apophysaire de *Centronella* semble, en effet, avoir beaucoup d'analogie avec un premier stade observé par M. Friele dans le jeune age de *Macandrevia* (*Waldheimia*) *cranium*, au moment où la partie récurrente n'est représentée que par deux minces lamelles verticales juxtaposées. Toute fois ces lamelles qui bientot se réfléchissent pour former un tube fermé à la partie postérieure, sont reunies à un septum dorsal, ce qui n'existe pas dans *Centronella* et en particulier dans le *C. Guerangeri* qui possede toujours chez les adultes un appareil entiérement libre, ainsi que nous avons pu le constater chez un grand nombre d'individus."

With respect to *Notothyris* Dr. Waagen writes me that his genus has the same configuration of the hinge-plate and crura as *Centronella*; and he gives an illustration in pl. 28, fig. 4, of his work on the Brachiopoda of the Salt Range, of his type, *Notothyris subvesicularis*, Dav. sp.; but Dr. Waagen writes me also that he is very

doubtful if the loop of *Notothyris*, as he has figured it, is complete; and, as I cannot help thinking that it is not so, I would not like to place the genus among the *Centronellidæ* until this point shall have been satisfactorily settled.

The genus *Leptocœlia*, Hall, 1859, type *L. flabellites*, has always puzzled me; for, as remarked by Œhlert, the distinguished American palæontologist has classed two very different forms under *Leptocœlia*. The *Leptocœlia* of 1857, type *L. concava*, possesses spirals, and is the type the same author subsequently adopted for his genus *Cœlospira*. Taking therefore *L. flabellites* as the type of *Leptocœlia*, M. Œhlert considers it to bear much affinity to the forms that constitute the genus *Centronella*.

I think it will therefore be advisable, at least provisionally, to place *Centronella*, *Leptocœlia*, and *Rensselæria*, in a sub-family following that of the *Terebratulidæ*.

Family—THECIDEIDÆ, Gray, 1840.

Until quite recently the family *Thecideidæ* was known to comprise the genus *Thecidium* only, which genus was proposed by Defrance in 1828. It occurs in the Trias, and continues to be represented up to the present time by two species only.[1] Dr. Waagen states, at p. 393 of his work already alluded to, that "In the Alpine Trias, however, there appear at the side of the true *Thecideæ* yet other forms, which have received from Gümbel the name of *Pterophloios* ('Geogn. Beschr. d. bayr. Alpengeb.,' p. 411, 1861). Already Gümbel suspected the Brachiopod nature of these fossils, but it was not before the year 1880 that Zugmayer was in a position to prove their affinity beyond any doubt, and to demonstrate that they were most nearly related to *Thecidea*, Defr.[2] Zugmayer, however, went too far in this direction, inasmuch as he united *Pterophloios* entirely with *Thecidea*. Though a certain affinity between the two fossils can certainly not be denied, yet their generic union cannot be advocated. *Pterophloios* is different in certain very important points from *Thecidea*. In the large ventral valve the area and pseudo-deltidium are decidedly absent, the cardinal teeth are very little developed, and a long and strong median septum extends from the apex to the anterior margin. Traces of numerous radial septa are also present. In the smaller, dorsal valve the cardinal process is very small; but otherwise the arrangement of the brachial apparatus is very similar to that of *Thecidea*. It now appears to me that the peculiar structure of the ventral valve is sufficient to distinguish generically between *Thecidea* and *Pterophloios*, and that thus the latter genus might very well be retained."

[1] *Thecidium Mediterraneum* and *Th. Barretti*. See Davidson "On Recent and Tertiary Species of he Genus *Thecidium*," 'Geol. Mag.,' 1864.

[2] *Thecidea Emmerichi*, Gümbel, H. Zugmayer, "Untersuchungen über Rhätische Brachiopoden" ('Beiträge zur Paläontologie Oesterreich-Ungarns'), von E. V. Mojsisovics und Neumayr, Bd. i, p. 19 pl. ii, figs. 17—32, 1880.

According to Dr. Waagen's views the family THECIDEIDÆ, would comprise:

1. Sub-family *Megathyrinæ*, Dall; including *Argiope*, Desl, *Cistella*, Gray, *Zellania*, Moore.

2. Sub-family *Thecideinæ*, Dall; including *Thecidea*, Defr., and *Pterophloios*, Gümbel.

3. Sub-family *Lyttoniinæ*, Waagen; including *Lyttonia*, Waagen, *Oldhamina*, Waagen.

And he adds that the sub-family *Megathyridæ* would be a convenient transitional link between the *Terebratulidæ* and the *Thecideidæ*. This may be so, but I am not yet prepared to include the *Megathyrinæ* as a sub-family of *Thecideinæ*, and would prefer, at least provisionally, to leave *Argiope*, *Cistella*, and *Zellania* as a sub-family of the *Terebratulidæ*.

In a very instructive paper, entitled "Note sur quelques espèces nouvelles de Mégathyrides,"[1] M. G. de Morgan strongly urges the adoption of A. d'Orbigny's generic name *Megathyris*, 1847, in preference to that of *Argiope*, E. Desl., 1842, on account of the generic name *Argiope* having been previously given by Latreille to a genus of Spiders.

In 1853 Count Keyserling described a fossil from the Carboniferous Limestone of the Ural under the name of *Thecidium filicis*, which was subsequently figured by Möller in the 'St.-Petersburg Mining Journal.'[2]

Sub-family—LYTTONIINÆ, *Waagen*, 1883.

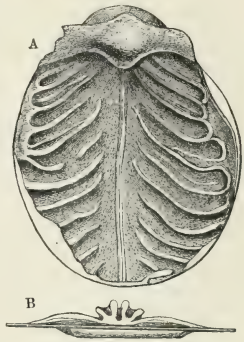
"Shell of large size, flat or vaulted, attached by the larger valve; hinge-line straight but short, no area or pseudo-deltidium; internally, the ventral valve with a median and numerous lateral septa; dorsal valve rudimentary, forming together with the brachial apparatus one strongly-lobed shelly plate, which fits between the external septa of the

[1] 'Bulletin de la Société Zoölogique de France,' vol. viii, 1883. The author remarks "that with the *Megathyris* as well as with the other Brachiopoda the long and flexible cirri, with which the two membranous appendages are garnished, are destined to produce in the water a disturbance which draws the nutritive particles to the mouth of the animal. Nevertheless, in this group of animals one can discern neither special buccal whirlwinds nor any fixedness in the direction of the currents or flow of the particles attracted towards the brachial disc; they show a tendency to go to the centre notwithstanding that the mouth is eccentric, then they are rejected in any direction, and return now and then to the same place after having at several renewals made the round of the apparatus. However, the septums of their shells force back before them the cirri and tend to disturb this equilibrium. The *Megathyrides* (or *Argiopes*) are, if we credit M. J. Hérouard, the worst organised of the Brachiopoda with respect to nutrition; therefore the author in his classification of the genera with regard to their nutritive faculties places them in the last rank after the *Thecideidæ*, whose apparatus, although analogous, produces very different effects." In this paper M. de Morgan gives the list of all the species of *Megathyris* (or *Argiope*) and *Cistella* known to him. The paper is illustrated by a well-drawn plate and by many woodcuts.

[2] "Description of the Carboniferous Brachiopoda of the Ural," 'Annales des Mines Russes,' vol. iv, 1862.

large valve. From this definition it appears clearly in what essential points this sub-family deviates from the *Thecideinæ*. Yet I think these forms ought to be retained in the family *Thecideidæ*, as the most striking characters of family,—the punctate shell, the lobed brachial apparatus, and the attached larger valve persist, though under such very strange modifications. There are two genera which I comprise in the sub-family, the genus *Lyttonia*, Waagen, and the genus *Oldhamina*, Waagen."

"The genus *Lyttonia*, so far as known, is exclusively of eastern distribution. Two species of it occur in the Salt Range as well as in the Himalayas; a third species has been described by Kayser as a fish tooth under the name of *Leptodus Richthofeni*,[1] from the Upper-Carboniferous beds of Lo-Ping in China." I am, however, uncertain whether the *L. Richthofeni* of Kayser is really a Brachiopod. Prof. Lindström writes me that he is convinced that it is so, and that it belongs to the family *Productidæ* and is nearest akin to *Strophalosia*. Dr. Waagen says (p. 403) that specimens of the genus *Oldhamina* "have been long known, but they have always been considered as univalve, and were in consequence compared by L. de Koninck to *Bellerophon*."[2] "The shell," adds Waagen, (p. 404) "is composed of two valves, one smaller and one larger, corresponding respectively to the dorsal and ventral valves of the Brachiopoda. The ventral valve is much more solid, compact, and externally entirely smooth, only covered by tolerably numerous concentric striæ of growth. It is at the same time very strongly vaulted, nearly hemispherical, and strongly bent over in the apical region. In consequence of this the hinge-line is not visible, being covered up by a thick callosity, which envelops the apical part of the valve and extends on both sides in wing-like expansions, rolled up spirally. . . . . The dorsal valve is constructed very much as in *Lyttonia*. It is strongly concave, and consists of a longitudinal solid middle piece, to which are attached laterally long narrow shelly lobes, separated from each other by deep narrow incisions, into which fit the lateral septa of the ventral valve."



Oldhamina decipiens (after Waagen).
A. Ventral valve, internal view.
B. Cardinal view of the dorsal valve.

We have long known that in some species of *Thecidium*, such as *Th. leptænoides*, Deslongchamps, *Th. Mayalis*, Desl.,[3] and *Th. Bouchardi*, Dav., the dorsal valve does not attain to much more than half or two-thirds the length of the ventral valve, so

[1] "*Leptodus Richthofeni*," Kayser, in Richthofen's 'China,' vol. iv, p. 161, pl. xxi, figs. 9—11, 1882.

[2] De Koninck, 'Quart. Journal Geol. Soc.,' London, vol. xix, p. 8, 1863, and 'Fossiles Paléoziques de l'Inde,' p. 15, 1863.

[3] "Sur les genres Leptæna et Thecidea des Terrains Jurassiques du Calvados," 'Mémoires de la Soc. Linnéenne de Normandie,' vol. ix, 1853; see also my Jurassic Supplement, Pl. XIII, fig. 1.

that a large portion of the last-named valve remains uncovered by the dorsal one. This character I have not observed in any other family or genus except in that of *Thecidium*. It may therefore be desirable to follow Dr. Waagen while dividing the family *Thecideidæ* into two sub-families. Our British Rocks have not hitherto revealed any representative of the *Lyttoniinæ*.

Family—SPIRIFERACEA, Waagen, 1883.

At p. 135 of my 'Silurian Supplement,' Mr. Glass and myself proposed a new grouping of the spiral-bearing genera, and which, although no doubt liable to improvement, seemed to us then, as it still does, to be as nearly natural as we could make it with the material and information in our possession. I need not here recapitulate the numerous and very important discoveries effected by the Rev. Norman Glass during his prolonged and able investigations, as they have been fully recorded in my 'Devonian' and 'Silurian Supplements.' To Mr. Whitfield we are likewise indebted for much valuable information and some excellent preparations, which were described and illustrated by Prof. J. Hall in his large and important work on the 'Palæontology of New York.' Several successful and some more or less satisfactory efforts in the same direction, all adding to our knowledge, have been effected by W. King, E. Suess, E. Deslongchamps, Zugmayer, Waagen, and others, which have materially added to our knowledge.

All the genera and species of this great and important family have been shown to be possessed of lamellæ spirally coiled in different ways and directions for the support of the labial appendages. In *Atrypa*, as in *Rhynchonella*, the fleshy arms were similarly coiled and directed, but in the first-named genus they were supported throughout by a shelly ribbon-shaped and coiled lamella, while none of the species or genera composing the *Rhynchonellidæ* had their labial appendages supported by coiled lamellæ (see 'Appendix to Supplement,' Pl. XXI, fig. 3). The labial appendages in *Rhynchonella*, as already shown, can be uncoiled to some extent at the will of the animal, but it is very doubtful that this action was possible with any of the *Spiriferidæ*. In their many genera the spirals are connected by a more or less complicated system of the lamellæ, and to exhibit these the Rev. Norman Glass, Mr. Whitfield, myself, and some others have devoted much time and labour.

The spiral coils and connections in *Anoplotheca*, Sandberger, have not been sufficiently worked out in detail. Those of *Koninckina* have been well described and figured by several palæontologists; and Herr Zugmayer has informed me, by letter that, in a large form, named *K. quadrata*, from the Hallstatt Beds (Étage Norique, according to Mojsisovics), near Hörnstein, to the South-west of Vienna, he found the spirals to be free as in *K. Leonhardi*, and that, in addition to being free, they are double in both species, and composed of a primary coiled lamella and of an accessory one, which last

inclines obliquely towards the principal lamella, the spirals being vertically arranged. Mr. Glass, however, reminds me that the inclination of the secondary lamellæ occurs sometimes in *Kayseria*, but that he does not regard it as a permanent or important feature, or as one upon which characteristic differences can be based. It is just according to the way in which the two lamellæ (primary and secondary) happen to lie at their attachment to the dorsal valve, and it would be very peculiar if they hung quite level to each other all through, or otherwise. This subject, however, demands further investigations.

Dr. Laube in his 'Die Fauna der Schichten von St.-Cassian,' 1865, describes a new genus, *Amphiclina*, and his figures lead Herr Zugmayer and myself to suppose it to be a variation of *Koninckina*, but as no figure is given of its spirals, it is not possible to speak decisively upon the subject. *Koninckella* is stated by M. Munier-Chalmas to be possessed of spirals similar to those of *Koninckina;* but he has not yet, I regret to say, given any figure of them. *Davidsonia* is known to have been provided with spirals, but the family or sub-family to which it should be referred has not yet been satisfactorily determined.

Since giving an account of Mr. Glass's and my own researches in connection with the *Spiriferidæ* in the first and second portions of my 'Silurian Supplement,' I have received from Dr. Waagen the second part of his work on the 'Carboniferous Brachiopoda' of the Salt Range, in which, while acknowledging the importance of the investigations effected by Mr. Glass and myself, he gives the results of his own researches in connection with this difficult and very interesting subject.

Dr. Waagen was not, however, acquainted with the new arrangement of the genera which Mr. Glass and myself proposed in the second part of my 'Silurian Supplement,' and his operations have been limited to the very small number of spiral-bearing genera that occur in the Carboniferous rocks of India; and these being much silicified are very difficult to work, so that he has had, he says, to follow a somewhat different process[1] to the one adopted by Mr. Glass.

[1] "The mode in which I operated was generally the following: The ventral or dorsal valve, according to the side which I wished to expose, was carefully chipped off, then the matrix was smoothed down cautiously, with a sculptor's rasp and occasional application of diluted acid, to near the spiral coils, and then diluted acid was applied with a brush, and an occasional touch of the rasp to remove the siliceous parts until the spirals and their connections became visible. At the same time it was necessary to cover the parts which were already sufficiently exposed, and had to be protected from the action of the acid, with sealing-wax or Canada balsam. This mode of proceeding requires a great amount of time, as the specimen must over and over again be dried and warmed for the application of the Canada balsam. With great patience and care at last sufficiently clear preparations can be obtained in this manner to arrive at satisfactory determination of these fossils. The sparry lamellæ of the spiral cones and other parts come out then as dark lines on the grey matrix. The process of cutting the matrix with a knife was not applicable on account of the siliceous ingredients of the rock, making it of very unequal hardness at certain places, so much so that it was only by dissolving the calcareous matter that the siliceous parts become sufficiently disintegrated for removal" (*op. cit.*, p, 448).

Dr. Waagen divides the spiral-bearing Brachiopoda into the following three families, seven sub-families, and genera:

Sub-order Helicopegmata, *sive* Spiriferacea, Waagen (*op. cit.*, p. 447).

I. Family Atrypidæ, Dall, and in this he would include the genera *Atrypa*, Dalman, and *Cœlospira*, Hall.

In a sub-family he places *Koninckina*, Suess, *Anoplotheca*, Sandberger, and *Koninckella*, Munier-Chalmas. For this sub-family, characterised by shelly spirals, coiled up nearly in one plane, he proposes the name of *Koninckininæ*. This I had previously done in 1853, but he rejects from it the genera *Thecospira*, Zugmayer, and *Davidsonia*, Bouchard.

In another sub-family, *Zygospirinæ*, he would include *Glassia*, Dav., *Zygospira*, Hall, and *Anazyga*, Dav.

II. *Family*.—Athyridæ, Phillips.

1. Sub-family *Meristellinæ*, Waagen; "the loop connecting the two spiral cones is of a very characteristic shape, having at its upper forked extremity two ring-shaped processes, and being altogether directed towards the apical part of the shell," a character pointed out for the first time by Prof. J. Hall.

2. Sub-family *Athyrinæ*, Waagen. This sub-family is characterised by a loop directed towards the frontal part of the shell, but sending backwards towards the apex a forked process, to which are frequently attached accessory lamellæ; it comprises *Athyris*, M'Coy; *Kayseria*, Dav.; *Whitfieldia*, Dav.; and *Bifida*, Dav., as well as a new genus, *Spirigerella*, Waagen, type *Sp. Derbyi*.

Dr. Waagen intimates that the internal arrangement of this genus, so far as it could be ascertained, is to a certain extent identical with that of *Athyris*, but is distinguished by its exceedingly large cardinal processes.

III. *Family*—Nucleospiridæ, Dav.

1. Sub-family *Retziinæ*, Waagen. Dr. Waagen (*op. cit.*, p. 486) includes in this sub-family *Nucleospira*, Hall; *Retzia*, King; *Meristina*, Hall; *Hindella*, Dav.; ? *Trematospira*, Hall; and *Eumetria*, Hall.

2. Sub-family *Dayinæ*, Waagen.

3. Sub-family *Uncitinæ*, Waagen.

With respect to the genus *Eumetria*, Dr. Waagen enters into long details, and says that it has been very imperfectly known, and it is not without much uncertainty that he assigns the Salt-Range forms to Hall's genus.

"The genus," he says (p. 487), "has never been properly described by Hall. The name was introduced in 1863 in the 'Sixteenth Regents' Report of the New York State Cabinet,' p. 59, for the shells of the type of *Retzia serpentina*, de Kon.; but this

species itself is of a very problematic nature as to its generic relations, and it is very doubtful if the figure in Woodward's 'Manual' represents what was assigned by de Koninck under the name. Dall has, therefore, very properly considered *Retzia vera*, Hall, as the type of the genus, which species, somewhat earlier in the text (page 55), was figured by Hall as a representative of the *serpentina* type. If we take this species as the type, we can then find out approximately what is denoted by the name."

Anyhow, rightly or wrongly, Dr. Waagen considers the *Eumetria grandicosta* (*Retzia radialis*, Phil., var. *grandicosta*, Dav., 'Quarterly Journal Geol. Soc.,' London, vol, xviii, p. 28, pl. 1, fig. 5, 1862) as a type of the genus, and gives a detailed description, accompanied by figures showing the spirals and their connections, which we here reproduce, as it is desirable to record all that has been discovered on this important subject. Dr. Waagen says that it is highly probable that the Indian species of the genus are in a developmental connection with the respective European species. We have thus (Waagen, *op. cit.*, p. 490, &c.):

I. Group of *Eumetria radialis*, Phil., sp.

1. *Eumetria grandicosta* (Dav., sp.), Waagen.

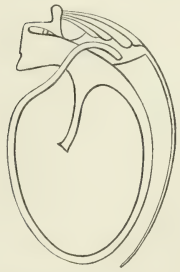
II. Group of *Eumetria ulotrix*, Kon., sp.

2. *Eumetria indica*, Waagen.

The real type of *Retzia* is the *Retzia Adrieni*, de Verneuil, but hitherto it has not been possible to obtain suitable specimens so as to be able to develop its interior character, and consequently the *Retzia Salteri* has been the species upon which the characters of the genus have been described by Mr. Glass and myself. They differ in several respects from the figures and description given by Dr. Waagen of *Eumetria* as typified by the so-termed *Eumetria grandicosta*.

"The internal characters of the shell," says Waagen, at p. 488, "are very peculiar. The ventral valve is very simple inside: from the straight hinge-line there project, not far distant from each other, two small hinge-teeth, which are otherwise in no way remarkable; they are not supported by dental plates, and are not continued inside the area as projecting ridges. . . . The dorsal valve has a very complicated brachial apparatus. The cardinal process consists of a transversely elongate, squarish, upright plate, which extends below the area of the larger valve, and between this plate and the apex of the dorsal valve the median part of the area is so firmly wedged in that it is impossible to separate the two valves without breaking off the middle part of the area, which then remains sticking in its place, and can only with great difficulty be removed. On both sides of this cardinal process are the dental sockets, which are very small for the reception of the small hinge-teeth. Anteriorly and somewhat above the dental sockets the crura take their origin. The cardinal process or hinge-plate, as one might like to call it, is produced below into a stout hooked process, which is again supported by a small semilunar septum, which latter, however, seems to be only rudimentary in some cases. The hooked process shows much similarity to the curved tube which

encloses the visceral canal in some species of *Athyris*, and which terminates at the apex of the valve in the visceral foramen. . . . The crura, as has been said above, take their origin on both sides of the cardinal process at the margin of the dental sockets. They are slender, not very long, rather straight, and extend in an obliquely ascending direction. They join the primary descending lamellæ of the spirals with a very acute bend. The primary lamellæ are very strange in their development. They show broad wing-like expansions at their origin, which are sometimes very strongly developed, as in the specimen figured in the woodcut, sometimes less so, but they are always present. Very near below the origin, from the broad part of the primary lamellæ, the loop proceeds. It consists of two slender, nearly quite straight lamellæ, which converge about in the direction of the longer axis of the valve towards the middle, and unite in forming a little sharply-pointed spur, which is directed obliquely towards the apical part of the valve. From the origin of the loop the primary lamellæ taper very quickly.



Eumetria grandicosta, Dav. sp. (after Waagen). Lateral view of the loop and primary lamellæ.

"The spirals are very loosely coiled, and consist of six to eight volutions. Whilst the primary lamellæ on the dorsal side approach each other very nearly, their recurving branches on the ventral side are rather distant from each other, so that the entire loop lies open to inspection. . . . From this description it appears that the shells which I subsume under the name of *Eumetria* can be very well distinguished generically from other genera of the sub-family. The most striking features are the wing-like expansions of the primary lamellæ, the origin of the loop so near the commencement of the primary lamellæ, and its extension forward in a horizontal direction, just the opposite of what takes place in the genus *Hindella*. The genus *Eumetria* thus seems to be much more removed from the remainder of the genera of the *Retziinæ* than the genera *Nucleospira*, *Retzia*, and *Meristina* are from each other."

Dr. Waagen states likewise that a somewhat more circumstantial description of the internal parts will be found in Derby's paper on the Brachiopoda of the Itaituba Province of Pará, Brazil,[1] a paper which is full of much valuable information about the interior structure of these Molluscoids.

I have given these lengthened extracts from Dr. Waagen's work because it is probable that one or two of our British species, when better known, may perhaps have to be referred to the genus *Eumetria*.

In his sub-family *Uncitinæ* (p. 494) Dr. Waagen proposes a new genus *Uncinella*, type *U. indica*, Waagen, but says that its internal characters could only be partly made out.

[1] 'Bulletin of the Cornell University of Science,' vol. i, No. 2, p. 4, 1874.

For the family Spiriferidæ the same German palæontologist proposes several sub-families (*op. cit.*, p. 498 *et seq.*) :

1. Sub-family Suessiinæ, Genus *Spiriferina*, d'Orb.
2. Sub-family Delthyrinæ, Genus *Spirifer*, Sow.
3. Sub-family Martiniinæ, Genus *Martinia*, M'Coy, and *Martiniopsis*, Waagen.
4. Sub-family Reticulariinæ, Genus *Reticularia*, M'Coy.

I think Dr. Waagen correct while generically separating those species of *Spiriferidæ* with a perforated shell-structure from those that have a fibrous and not punctured shell. This view is also taken by Prof. Bayle, and for which reason he maintains the genus *Martinia*, M'Coy. This character was not, however, known to M'Coy when in 1844[1] he proposed his genus, and did so on the mistaken supposition that the spiral appendages were small, but which is not the case, as has been amply proven by myself and from Mr. Glass's many and perfect preparations of the spirals of *M. glabra*, of which I have given figures in the first part of my 'Carboniferous Supplement.'

We are, therefore, gradually advancing in our knowledge of the characters of the spiral-bearing genera and species, and I have every hope that with renewed exertions still more information will be acquired, and that with time a correct and permanent grouping of the genera will become possible.[2] Dr. Waagen when treating of his genus *Martiniopsis*

[1] 'Synopsis of the Characters of the Carboniferous Fossils of Ireland,' p. 139, woodcut, fig. 22, 1844.

[2] Previous to leaving the subject in connection with the *Spiriferidæ* I would mention that for many years past it has been observed that in some species of long-hinged forms of Brachiopoda there are present numerous small denticulations, as well as vertical lines on the area, proceeding from each of these denticulations. These I figured in *Strophodonta demissa* (Conrad) in the 'Geologist' for March, 1859; and the same thing has been observed in other species by more than one palæontologist. Recently, however, while examining some weathered fossiliferous shales from the Lower-Carboniferous strata of East Kilbride, in Lanarkshire, Mr. John Young's attention was attracted to some fragments of the valves of *Spirifera trigonalis*, Martin, in which he noticed, on the hinge-line of the dorsal valve, a row of small, rounded, hollow pits, and on the hinge-line of the ventral valve corresponding projecting rounded denticles, which fitted exactly into the little hollows on the hinge-line of the opposite valve, and thus in a measure assisted to steady the valves, especially when the hinge-line was long and the teeth not very large. Mr. Young has published the results of his researches on this subject in the 'Geological Magazine,' new series, decade iii, vol. i, p. 18, 1884. He says that "the denticles, when looked at externally, are nearly as numerous and of much the same size as those seen in many of the hinge-lines of shells of the genus *Arca*, only in this genus the teeth are the same in each valve and lock into each other. The denticles, as already stated, project from the outer edge of the hinge-line of the ventral valve, which is seen to be bevelled from within outwards so as to present a moderately sharp edge, and on this edge the denticles are situated. On a specimen measuring one inch and three quarters in length along the hinge-area thirty-five of these denticles may be counted on each side of the central triangular fissure. It had long been noticed that in the shell-structure of the external surface of the hinge-line area in the ventral valve of many of the species of *Spirifera* as well as in others of the straight-hinge Brachiopods, there exists a series of vertical lines or tubes, slightly inclined

Spirifera trigonalis (Martin), after Young.

Diagram, nat. size, to show the denticulated hinge-line in the ventral valve, and little corresponding pits in the hinge-line of the dorsal valve.

adds that the punctated epidermis seems to be more easily destroyed on the true *Martinia* than on *Martiniopsis*, in which it is much better and more frequently observed.

Family—RHYNCHONELLIDÆ.

This is a most important family among the Brachiopoda, and has been treated of at great length in the pages of this Monograph. It seems also to be one of the best circumscribed. Dr. Waagen, in his work on the Salt Range, proposes some alterations in the classification of the genera composing it. At page 409, he says "that if the interior of the different shells were better known, a greater number of well-defined genera would be distinguishable in this family also as well as in the *Terebratulidæ* and *Spiriferidæ*. As it is, there can be distinguished at once three large groups of forms among the shells belonging to the family. The first is characterised by a very insignificant development of internal septa. In the ventral valve generally only dental plates are present, which do not unite in the middle line, and in the dorsal valve a not very conspicuous median septum is developed. In the second group of forms the internal septa are much more strongly developed and have gained much in extent. The dental plates converge towards the middle and form also in the ventral valve a more or less extended median septum. The septum in the dorsal valve is also generally rather large and high, and bears often at its upper end shelly expansions. In the third group at last the internal septa have reached their maximum of development. The whole inside of the shell is divided by them more or less distinctly into five chambers, one median, marked off by the dental plates of the ventral valve, and the lateral expansions of the two septa in the dorsal valve, and two lateral chambers outside of the median septa in both valves." These divisions well correspond to Waagen's three sub-families *Rhynchonellidæ*, *Camarophoridæ*, and *Pentamerinæ*.

The *Rhynchonellidæ* comprise a very large and most perplexing number of species,

and waved in some specimens, but more often straight in others." These lines have been often observed and figured, "but, so far as I am aware, no one has noticed or described these lines or tubes as forming and corresponding with a row of denticles along the edge of the valve in the specimens on which they are found. . . . Some of the lines bifurcate in their upper extremity, but the greater majority are single, and they slightly increase in thickness as they approach the edge of the hinge, in which they are seen to be continuous with the denticles. . . . I am now inclined to regard them as having been originally composed of vertical lines of aragonite in the shell-structure, which, being harder than the ordinary calcite of the shell, went to the formation of the row of denticles. These lines are now seen to be composed of a coarser and more structureless kind of calcite than that forming the hinge-area of the shell, and it often weathers into hollow grooves upon the external surface, or when the lines have been etched with acid," &c. In his paper Mr. Young enters upon many details in support of his views, but which space will not enable us to transcribe.

and the interiors of the larger number of them are still unknown, so that it is not yet possible to class them all into really good and distinct genera; still it is evident that some attempt in that direction will have to be made.

I have retained the genera *Rhynchonella*, Fischer, 1809; *Rhynchopora*, King, 1856; *Eatonia*, Hall, 1857;[1] *Dimerella*, Zittel, 1870;[2] *Atretia*, Jeffreys, 1876;[3] and provisionally, *Terebratuloidea*, Waagen, 1883. Dr. Waagen and M. Œhlert would also admit the genera *Uncinulus*, Bayle;[4] *Rhynchotrema*, Hall;[5] *Rhynchonellina*, Gemmellaro, 1871;[6] *Acanthothyris*, d'Orb,[7] and some others, which I am not yet prepared to admit. One or two of them may perhaps be worth retaining.

Dr. Waagen, at page 413 of his 'Salt-Range Fossils,' 1883, proposes a genus *Terebratuloidea* for a Rhynchonella-shaped shell, in which he believes the beak to be never entire, but always truncated and pierced at its end by a large oval foramen; while in true *Rhynchonella*, as is well known, the beak is pointed and entire, the foramen being situated under its angular, incurved extremity. If this character is really demonstrated to be constant, the genus *Terebratuloidea* should be retained. Unfortunately, all the specimens of the genus that have passed through my hands for examination had the extremity of their beak much worn. Dr. Waagen describes his genus *Terebratuloidea* as being "more or less transversely oval or rounded, in its general appearance *Rhynchonelloid*

[1] 'Twelfth Regents' Annual Report New York State Cabinet,' p. 35, 1869. Has no dental plates in the ventral valve, a strong median septum in the dorsal valve, with four curved crura instead of two.

[2] 'Palæontographica,' vol. xviii, p. 220, 1870. A large area in the ventral valve, and a very high and long septum in the dorsal one.

[3] "Preliminary Report of the Scientific Explorations of the Deep Sea in H.M.S. 'Porcupine,'" 'Proc. Royal Soc.,' No. 121, p. 421, 1870; also Dav. 'Sup.' (vol. iv), p. 7, Pl. I, figs. 7—10.

[4] In his magnificent volume of plates, 'Explication de la Carte Géologique de France,' vol. iv, Atlas, 1878, Prof. Bayle proposes a genus *Uncinulus* for such shells as the Devonian *Rh. sub-Wilsoni*, d'Orb., *R. Œhlerti*, Bayle, *Rh. imperatrix*, Bayle, *Rh. fallaciosa*, Bayle, &c., but he gives no description of the characters of his genus. At p. 690 of his 'Handbuch der Paläontologie,' 1880, Prof. Zittel alludes to a genus *Wilsonia*, Quenstedt, but Dr. Waagen informs me that a genus *Wilsonia* was never proposed by Quenstedt, and does not exist. Quenstedt speaks of "*Wilsonier*" ('Die Brachiopoden,' p. 193, 1871) as he speaks of "*Bicorner*," just as a collective name and never as a genus, and therefore, if we are to admit a genus for similar species to those named by Prof. Bayle, the name *Uncinulus* would claim priority. In the 'Annals and Mag. of Nat. Hist.,' 2nd ser., vol. ix, 1852, while treating of the genus *Rhynchonelia* I gave figures of the interior of both valves of true *Rhynchonellæ* as well as of some of the species which would be included in Bayle's *Uncinulus*, but I am not yet satisfied as to the necessity of separating those species from *Rhynchonella*. In a letter to me M. Œhlert expresses the opinion that both *Uncinulus* and *Eucharis*, Barrande, may perhaps be good genera and worth retaining; thus with time it may be possible to add to the number of genera that should be comprised in the sub-family *Rhynchonellinæ*.

[5] 'Thirteenth Regents' Report New York State Cabinet,' p. 65, 1860.

[6] 'Studii Paleontologici: sulla fauna del Calcaris a *Ter. janitor*,' iii, p. 29, 1871. Large area and straight hinge-line, the dorsal valve with very long, sometimes bifid crura.

[7] 'Annales Sci. Nat.,' xiii, p. 523, and 'Pal. Franç., Ter. Crétacés,' vol. iv, p. 343, 1850, for *Rh. spinosa*.

with strongly plaited valves and a high median fold in the dorsal, and a corresponding sinus in the ventral valve. Hinge-line curved, beak truncated, with a terminal round foramen; deltidium formed of two distinct plates, which limit the foramen below only for a very short distance. Internally, the ventral valve with two strong hinge-teeth, which are, however, not supported by dental plates. The dorsal valve bears a tolerably large triangular hinge-plate, which is united on both sides by the deep dental sockets, and is triangularly cut open in the middle up to the very apex of the valve, which also is a little cut out. There is no cardinal process. On both sides of the median incision very short curved crura take their origin, and proceed for a short distance in a slightly diverging direction towards the interior of the shell. There is no median dorsal septum. . . . All the internal partitions, which are characteristic for *Rhynchonella*, the dental plates as well as the dorsal septum, are absent in *Terebratuloidea*. . . . I cannot positively assert that the beak has never had the shape of the beak of *Rhynchonella*, but I can most positively say that I have never seen a specimen in which the beak was not truncated."

I am ready to agree with Dr. Waagen as to the propriety of dividing the family *Rhynchonellidæ* into the three sub-families, *Rhynchonellinæ*, *Camarophorinæ*, and *Pentamerinæ*. It is quite evident, therefore, that although we are gradually advancing towards a more satisfactory classification, there is still a great deal more to be found out and explained before the much desired end can be attained.

Our tables show at a glance that the *Tretenterata*, with the exception of *Lingula*, *Glottidia*, *Craniscus*, and *Actinocrania*, were all essentially Palæozoic forms, and that the larger number occurred chiefly during the Silurian period; *Lingula*, *Discina*, and *Crania*, however, continuing to be represented with very similar shapes up to the present time.

The families *Terebratulinidæ* and *Thecideidæ* have been classed in thirty-three genera, and as far as we are aware ten have occurred in the Palæozoic Rocks, eighteen in the Neozoic, fourteen in the recent period, *Waldheimia* alone having ranged from the Silurian up to the present time, and two only having passed from the Palæozoic into the Triassic. (See pp. 353, 354.)

The family *Spiriferidæ* consists mostly of Palæozoic forms, which are chiefly *Silurian*, *Devonian*, and *Carboniferous*. Of the thirty-six genera quoted in our Table, thirty-two occur in the Palæozoic period, nine in the Mesozoic, and they disappear completely in the lower half of the Jurassic. (See Tables on pages 354 and 355.)

In the *Rhynchonellidæ* we have admitted twelve genera. Of these, ten occur in the Palæozoic Rocks, two in the Neozoic and recent, *Rhynchonella* alone continuing to be represented from the Silurian period up to the present time. The sub-families *Camarophorinæ* and *Pentamerinæ* are known only in the Palæozoic Rocks. (See Table, page 355.)

The families *Porambonitidæ*, *Orthisidæ*, *Strophomenidæ*, and *Productidæ* may be said to be all Palæozoic, the doubtful three so-termed *Leptænæ* from the Liassic period excepted.

What are the genera that should constitute the families *Orthisidæ* and *Strophomenidæ* cannot yet be finally determined. It is a large subject and demands further consideration and investigation. The species belonging to those two families are likewise very numerous.

In the *Orthisidæ* it will certainly be necessary to include such genera as *Orthis*, *Enteletes*, *Schizophoria*, and *Skenidium*. King would also place in the family his two genera *Platystrophia* and *Dicœlosia*, but which for the present I feel disposed to leave with *Orthis*.

The genus *Orthis* was proposed by Dalman in 1828 with the following diagnosis:—"Testa inæquivalvis, æquilatera; valva minori subplana, majori convexa. Margo cardinalis rectilineus, latus, foramine deltoideo sub nate valvæ majoris." In this genus he places nine species, viz. *Orthis ? pecten*, *O. striatella*, *O. zonata*, *O. callactis*, *O. calligramma*, *O. testudinaria*, *O. basalis*, *O. elegantula*, and *O. demisa*, but we must exclude from it the first, as he places a point of interrogation after the name *Orthis*. The second also must be excluded, for it belongs to the genus *Chonetes*. We would therefore take his *Orthis elegantula* or *O. calligramma* as the type of the genus *Orthis*, and this would agree with his diagnosis.

The name *Enteletes* was mentioned for the first time by Fischer de Waldheim in 1825, but he did not then describe his genus or refer to any species; and it was only in 1837 that he described his *Enteletes* in the 'Oryctographie du Gouvernement de Moscou,' p. 141. Fischer seems not to have understood or to have made up his mind with reference to the type of his genus. In 1809 he figured the type under the name of *Terebratula octoplicata*. In 1825 he gave to the same fossil the name of *Choristites Lamarcki*. In 1837 he applied to it two different names, *Choristites Lamarckii*, *C. Walcotti*, and *Enteletes*. MM. de Verneuil and d'Eichwald, knowing nothing of the characters of the fossil, described it by the name of *Spirifer Lamarckii*; and in 1876 von H. Trautschold in his fine work 'Die Kalkbrüche von Mjatschkowa, eine Monographie des oberen Bergkalks,' described and illustrated the exterior of the species under the name of *Orthis Lamarckii*; but none of the authors above named had been able to expose and describe the interior characters of the fossil; hence the confusion that ensued.

As the genus *Enteletes* is but little known, it will be as well to describe its type.

In external shape, *Enteletes Lamarckii* or *octoplicata* is wider than long and more or less globular, rarely exceeding some 13 lines in length by 17 in breadth and 13 in depth. The *dorsal valve* is generally very convex and especially so at the umbo, with two large prominent median ribs and one, two, or three on each of the lateral portions of the valve. The hinge-area is triangular, narrow, and sharply defined, about half the breadth of the shell. The beak is much incurved. The *ventral valve* is less convex than the dorsal one, with a deepened sinus, along the centre of which there exists an angular rib, and one or two ribs on either of the lateral portions of the valve; the area is well defined, from 5 to 7 lines in length by one in height, and divided along the middle by an open triangular fissure. The external surface of the valves is closely covered with

numerous thread-like, radiating, rounded striæ, which here and there augment in thickness and prominence, producing small, hollow, adpressed spines, similar to those observable in *O. resupinata*, *O. Keyserlingi*, and *O. Morganiana*.

None of the authors who have described the *Enteletes Lamarckii* seem to have been acquainted with the interior of its valves. I was, however, fortunate enough to procure a specimen from the Carboniferous Limestone of Mjatschkowa near Moscow, and after some patient labour was able to remove the hard white limestone that filled its interior so as to show its internal characters.

In the interior of the ventral valve a strong tooth is situated on either side of the base of the fissure, and from this converging prominent dental plates extend along the bottom of the valve to a little less than half its length. In the hollow between these plates or septa commences to rise a large, prominent, mesial plate, which becomes most elevated towards its anterior extremity. In the interior of the dorsal valve there exist two small curved lamellæ, somewhat similar to what we find in *Rhynchonella*, and to these in all probability were attached the spirally-coiled, fleshy labial appendages. Under the socket-pits and on each side two slightly deviating septa partly surround and enclose the muscular scars, and they are longitudinally divided along the middle by a narrow ridge.

These characters, in an allied species, the *Enteletes latesinuatus*, Waagen, have been well displayed and illustrated by Dr. Waagen in pl. 57, figs. 5 and 6 of the third part of his 'Salt-Range Brachiopoda.'

The so-termed genus *Syntrielasma* of Meek, 1872, is a synonym of *Enteletes*. In 1850 Prof. W. King proposed a genus *Schizophoria* to include such species as the *Orthis* (*Anomia*) *resupinata* of Martin; whether we should be justified in retaining this genus or of including it in the *Enteletes* group is a question still to be determined. The *Orthis Morganiana* of Derby seems to be intermediate in character between *Enteletes Lamarckii*, and *Schizophoria resupinata*, thus denoting the close relationship between the so-termed genera.

The genus *Skenidium*, Hall, seems to be well distinguished from *Orthis*, *Enteletes*, and *Schizophoria*, and is described at p. 48 of my 'Devonian Supplement.'

It is more difficult to deal in a satisfactory manner with the many genera that have been included in the family *Strophomenidæ*; all of them are distinguished from the *Orthisidæ* by having their triangular fissure arched over by a pseudo-deltidium.

1. *Orthisina*, d'Orb, 1847, type *O. anomala*, seems to be a well-characterised genus on account of its interior arrangements, which I fully described and illustrated in the 'Geologist' for March, 1859, as well as at p. 29 of my 'Permian Monograph.' It has been suggested that the generic name *Klitambonites*, Pander, 1830, should hold priority over that of *Orthisina*; but, as Pander gives several generic names to species presenting the same characters, I prefer retaining d'Orbigny's name, which moreover is now in general use.

2. *Meekella*, C. A. White and St. John, 'Transactions of the Academy of Sciences of Chicago,' p. 120, 1868, type *Meekella* (*Plicatella*), *striato-costata*, Cox. Dr. White states that the "broad dental lamellæ with the three rostral chambers, the plicated shell, and the unusually robust form, clearly separate the genus from *Hemipronites*. The rudimentary or obsolete area of the dorsal valve, and non-perforated and usually distorted ventral beak, separate it from *Klitambonites*, Pander=*Orthisina*, d'Orb.

3. *Streptorhynchus*, King, 1850, type *St. pelargonatus*, Schlotheim. "A Strophomenidia, inæquivalved, striated or ribbed, with the hinge approximating or equal to the width of the valves; umbones more or less divaricating, the large one irregularly twisted; fissure covered with a deltidium; dental plates small, projecting more at the base of the area than at its apex." Its small dental plates, &c., distinguish it from *Meekella*. King tells us, at p. 107 of his "Permian Fossils," that the genus consists of a small number of known species, and that *Strept. senilis*, Phill., *Strept. pelargonatus*, Schl., and *Strept. spurius*, Braun, are the only forms with which he was acquainted. Since then several forms have been placed in the genus *Streptorhynchus*, such as *Strept. crenistria*, and *Strept. arachnoidea*, which King had incorrectly placed in *Orthis*. One of the most beautiful species of the genus is the *Strept. pectiniformis*, Dav., described and figured in the 'Quarterly Journal of the Geological Society,' vol. xviii, pl. i, fig. 17, 1861, and according to Waagen, subsequently confounded by Messrs. White and St. John with a fossil much resembling it externally, which had been discovered in America by Cox, and to which he had given the name of *Plicatella striatocostata*, the type of White and St. John's genus *Meekella*. I am informed by Dr. Waagen that subsequently, after examining Punjab specimens of *Strept. pectiniformis*, Meek arrived at the conclusion that they were devoid of septa in the ventral valve, and consequently were not referable to *Meekella* ('Final Report on Nebrasca,' p. 176).

4. *Orthotetes*, Fischer, 1829, 'Bull. des Naturalistes de Moscou,' p. 375, and 'Orycto-graphie du Gouvernement de Moscou,' p. 131, tab. 20, fig. 4, 1837. The Russian type agrees with the *Strept. crenistria* of Phillips. Dr. Waagen writes that, although the description of this genus in the Russian work is unsatisfactory, yet if the laws of priority are to be followed, Fischer's name will have to be retained for shells agreeing with his figure and *Strept. crenistria*. If so, it will be necessary to remove several British species classed with *Streptorhynchus*, and to place them with *Orthotetes*. This subject will, however, require further consideration and investigation.

5. *Derbyia*, Waagen, 1884, type *D. grandis*, Waagen. I am uncertain with respect to the characters of this genus, which Dr. Waagen informs me by letter he has proposed for species with a median septum in the ventral valve and two diverging septa in the dorsal one. *Strept. senilis* serves as an example. Dr. Waagen describes several species of *Derbyia*, which I should have thought referable to *Orthotetes*.

6. *Strophomena*, Rafinesque, 1820, has caused much confusion. It should, I think, be restricted to forms that agree with *Strophomena rhomboidalis*.

7. *Strophodonta*, Hall, 1850. Type *Stroph. demissa*, Hall.
8. *Tropidoleptus*, Hall, 1857. Type *Trop. carinatus*, Conrad.
9. *Leptæna*, Dalman, 1828. Type *Lept. transversalis*, Dalman.

The question to be hereafter determined is whether all the foregoing genera are distinct, or if the number might not be reduced, especially in what relates to *Streptorhynchus*, *Orthotetes*, and *Derbyia*, which seem to be nearly connected and separable with difficulty.

The larger number of families and genera, as well as of species, prevailed during the Palæozoic period. The *Terebratulidæ*, however, predominated during the Neozoic time; and have been both generically and specifically most numerous along with the *Rhynchonellæ* in the Jurassic, Cretaceous, and Recent periods. During the Permian and Triassic epochs the Brachiopoda were comparatively poorly represented. Nineteen genera referable to six families are now found alive in our sea-bottoms.

Experience has taught us that, although some few cosmopolitan species occur in the same formation in districts far separate, it is not the less certain that the faunas referable to the same epoch at a distance, are mainly dissimilar, or show a great proportion of species peculiar and limited to the district in which they occur. The geological range of the larger number of species is therefore comparatively restricted, and numerous examples to this effect could be adduced.

As stated by Barrande in his admirable memoir 'Épreuves des Théories Paléontologiques par la réalité' the Brachiopoda, after the Trilobites, occupy the most important place in the Cambrian or Primordial fauna. Thus in 1871, out of 241 species known to him as composing the animal kingdom of that period, 179 were referable to the *Trilobites* and other *Crustacea*, twenty-eight to the *Brachiopoda*, while thirty-four species were divided between the *Annelida*, *Pteropoda*, *Gasteropoda*, *Bryozoa*, *Cystidea*, and *Spongida*. Subsequent to these statements, many additional species of Trilobites and Brachiopods and forms referable to other classes have been added to the list through the indefatigable researches of the late Prof. Linnarsson, Barrande, Dr. Hicks, and some others, but which do not invalidate the general conclusions arrived at by Barrande.

The *Brachiopoda*, together with the groups mentioned, are the earliest representatives of life at present known, for Dr. Hicks obtained undoubted examples of *Lingulella* and *Discina* from the very base of the Cambrian series in Wales. Although the Trilobites occupied the most important place in the Lowest Cambrian or primordial fauna, they fall short of their importance to the geologist when taken in comparison with the *Brachiopoda*, which have continued to be extensively represented from the base of the Lower Cambrian up to the present time, while the *Trilobites* are restricted to the Palæozoic period. They are also very characteristic fossils, by which rocks at great distances, whether in New Zealand or Spitzbergen, in the Himalayas or the Andes, can be identified without its being necessary for the palæontologist to visit the district from whence the fossils were derived.

It is impossible, in the present state of our knowledge, to offer more than a very

approximate numerical comparison of the genera and species that have existed during the various more or less extended geological periods; and many years will, I fear, have to pass away before some master mind will be able to grapple with the both scattered and accumulated observations of two and a half centuries, and reduce the number of genera and species within reasonable limits, so that something like trustworthy data may be adduced. Much of the confusion that at present prevails must be attributed to the still imperfect information on zoology and comparative anatomy among a large proportion of those who describe species, and who often, without having ascertained whether their so-termed species has not already been discovered and described, find it more convenient to give it a new name, and, to make matters worse, neglect in many cases to give a figure or illustration in support of their views. No new species should be admitted that is not accompanied by a figure; and this view has been recently advocated in a very decided manner by the International Congress held at Paris and at Bologna, and should pass as law.

But to return to our subject. I cannot do better than extract from Lyell[1] the following passage: "Nothing is more remarkable in . . . . the Silurian strata generally of all countries, than the preponderance of Brachiopoda over other forms of Mollusca. Their proportional numbers can by no means be explained by supposing them to have inhabited seas of great depth, for the contrast between the Palæozoic and the present state of things has not been essentially altered by the late discoveries made in our deep-sea-dredgings. We find the living Brachiopoda so rare as to form about one forty-fourth of the whole bivalve fauna; whereas in the Lower-Silurian Rocks, ... where the Brachiopoda reach their maximum, they are represented by more than twice as many species as the Lamellibranchiate Bivalves. There may, indeed, be said to be a continued decrease of the proportional number of this lower tribe of Mollusca as we proceed from older to newer rocks."

As already remarked, it is not possible, in the present state of our knowledge, to pretend to be able to arrive at anything definite or satisfactory with respect to the number of good species that have been discovered, as a very large proportion are in reality simply modifications in shape, and consequently synonyms. This lamentable confusion has also arisen in a great measure from the uncertainty which prevails in the Palæontologist's mind as to what should constitute a species, and where to draw a line between forms so nearly related that they seem to pass one into the other by insensible gradation. Nearly 300 genera or generic names have been proposed, and of these some 139 have been provisionally retained and recorded in my Tables. The genera, however, are not so numerous that they cannot be investigated and critically compared. To reduce the number of useless and confusing names must be the aim of future palæontologists. Then, again, the very great abuse of the name *variety* has in no small degree added to the confusion we have been gradually drifting

[1] 'Students' Elements, &c.,' 1874, p. 468.

into. When a form troubles the palæontologist, it is usual in order to get over the difficulty to make of it a "variety," whilst it is in reality no more than a modification in shape of the same variable species. But, alas, the tendencies of palæontologists have been to multiply so-termed "species" and "varieties," and not to reduce them within reasonable limits.

Mr. John Young, who has always shown himself to be a careful and accurate observer, writes to me that "When looking over *Productus semireticulatus* in his collection, Dr. L. de Koninck expressed the opinion that some of the varieties or variations in shape ought to be considered species; but I find that some of these varieties are only types of *Productus semireticulatus* that characterise this species in certain localities and on different geological horizons, and that it is seldom we find more than one of the varieties present in any of the particular beds in which the species is found. I could almost tell, without knowing the locality, the geological horizon of many of the varieties of our Scottish *P. semireticulatus* during the long life-history of the species from the Lower Calciferous Sandstone up to the Upper Limestone of our coal-field; and it is to be expected that varying conditions of sea-bottom would have some influence on the growth and form of the specimens, and that in the numerous returns of the species over the same tracts of sea-bottom, but on higher and higher horizons of strata, new varieties, or distinct races of the shell, if we may so term them, would naturally appear. The numerous alternations of land-surfaces and old sea-bottoms during the deposition of our Scottish Limestone strata would favour the introduction of these varieties more than in those sea-bottoms where the conditions remained equal over longer geological periods of time." [1]

Marie Rouault observes[2] . . . . "Nothing is more difficult to describe than a species of which all the individuals representing it differ among themselves in as marked a manner as this before us. Notwithstanding the difficulties that they cause, these differences may however be of very great use in the solution of the problem arising from them; for these differences, so strongly marked, observed between individuals of identical origin must have a cause, considering that, here as everywhere, varieties always result, either from different points of departure, or from the conditions in which they existed not having been exactly similar; if these differences continue they perpetuate the variety, which would then become a new perfectly-defined species." Therefore in the author's view all real varieties are the commencement of species, to perpetuate which it would be sufficient to maintain the conditions which caused their existence; and this also is the view of the case so ably expounded and maintained by Darwin. Under such conditions we should have real varieties, but they would differ materially from mere

[1] See a very instructive paper by Dr. L. de Koninck, "Sur la distribution géologique des fossiles Carbonifères de la Belgique" ('Annales de la Société géologique de Belgique,' vol. ix, p. 50, 1883. In this paper the learned Belgian palæontologist shows that the Carboniferous Limestone of Belgium and of Great Britain is divided into three distinct horizons, each of them being characterised by a distinct fauna.

[2] 'Œuvres posthumes de Marie Rouault,' par P. Lebesconte, 4to, Rennes and Paris, 1883; 'Notice sur les Amorphozoaires du Terrain Silurien de la Bretagne,' p. 21.

modifications in shape assumed by individuals of a single species which are so commonly found in the same bed or sea-bottom and confounded with real varieties.

Science progresses step by step, and I consider that what has been achieved during the last forty years is ample encouragement to prosecute investigations, so as to be able, with time and patience, to arrive at something really definite and satisfactory. A species cannot be properly understood, described, and illustrated by the simple inspection of one or two examples; a great many are required, especially at different stages of development, in order to ascertain its modifications in shape and character. The interior and the shell-structure must also be carefully examined and illustrated. The admirable results attained, but not until after much time and repeated trials, by the Rev. Norman Glass, Prof. J. Hall, Mr. Whitfield, Herr Zugmayer, Dr. Waagen, and some others, have amply proved that where there is a will there is a way, and that the hardest matrix can be removed from the interior of the fossil shell so as to expose its internal details and characters.

At different periods efforts have been made to draw up catalogues of the described species. Bronn, in his 'Index Palæontologicus,' 1848, gives a list of all the species known to him to have been described up to that year. Morris, in 1843 and 1854, published a catalogue of the then known British species. A. d'Orbigny, in 1849, gave in his 'Prodrome' a very incomplete catalogue of the Brachiopoda. S. A. Miller, in 1877, issued a catalogue of American Palæozoic fossils. Catalogues of the Silurian, Devonian, and Carboniferous species were published by the late Dr. Bigsby in his 'Thesaurus Siluricus' (1868) and 'Thesaurus Devonico-Carboniferus' (1878). But all these catalogues are compilations of so many so-termed species, without any really critical comparison (except in the case of Morris's 'Catalogue'), and serve as works of reference and not to indicate the real number of good species.

Dr. Bigsby informed me some time previous to his death that, from a conspectus of his two 'Thesauri,' the following numbers of Silurian, Devonian, and Carboniferous Brachiopoda had been arrived at with due regard to accuracy, but after all only forming a careful approximation, liable to future disturbances.

	American.	European.	Total.
Cambrian and Silurian	689	733	1422
Devonian	577	789	1366
Carboniferous	488	384	871
	1754	1906	3659

The number from the Permian formation, which completes the Palæozoic series, has not yet been computed, but it is comparatively small. Making a large allowance for synonyms, it will be seen that some 3000 so-termed species of Dr. Bigsby's list had up to

1868 and 1878 been described from the Palæozoic period; but very many more have been introduced since the date of Dr. Bigsby's publications.

It is remarkable that the Brachiopoda, so immensely abundant during the Palæozoic time, should have apparently become so much less numerous in the Permian and Triassic seas, while they became again very abundant, although in somewhat reduced numbers, during the Jurassic and Cretaceous periods. In the Tertiaries they had again materially decreased in number; and, as we have already shown, are represented at the present time by only rather more than one hundred species.

It has been clearly ascertained that a small number of genera and species have passed from one or more systems or formations into those that follow; and this will be seen by a glance at our Tables, in which the general distribution of the genera in time has been given with as much accuracy as the present state of our knowledge upon the subject will permit.

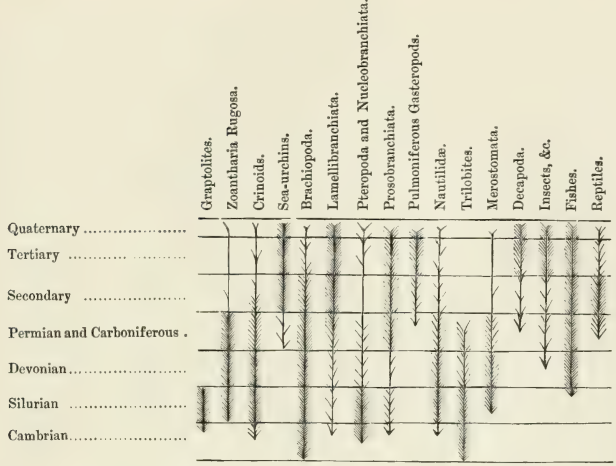
What wonderful changes have taken place during the incalculable number of ages in which reproduction and extinction of a large number of genera and thousands of species have taken place! Some few only of the primordial or early created genera, such as *Lingula*, *Discina*, *Crania*, *Waldheimia*, and *Rhynchonella*, have, as Darwin would say, fought their way and struggled for existence with but small, if any, alteration of shape and character throughout the entire sequence of geological time. By far the larger number of genera were destined to a comparatively ephemeral existence, while others had a greater or less prolongation of reproduction.

In a most instructive work by Prof. A. Gaudry, Member of the Institute of France, entitled 'Les enchainements du monde animal dans les temps géologiques: Fossiles primaires;' 1883,[1] the author remarks (at p. 296), "One of the most curious results of palæontological study has been to show that each one of the epochs of the world has had its own peculiar development. It has had forms which have been specially designed for it; with it they began their reign, with it their reign came to an end. This will be seen on glancing at the subjoined table, wherein I have indicated the path which the development of one part of the primary animals has followed. I have represented each group by a branch" (see next page), "which I have drawn more or less thickly clothed with leaves according as the development has been greater or less."

In the "Compte-rendu sommaire des Sciences," for the 7th of May, 1883 ('Bulletin de la Soc. géol. de France,' 3 sér., vol. xi, p. 439), we find a *résumé* of his views by M. Gaudry himself.[2]

[1] A good brief review of Prof. Gaudry's work, 'Evolution of Life in Palæozoic Times,' is published in the 'Geol. Mag.,' new series, decade 3, vol. i, p. 32, 1884.

[2] M. Albert Gaudry referring to the importance of noting facts derived from the study of Primordial or Palæozoic fossils, that are beginning to throw a little light on the plan of creation, said, "We do not know from whence were derived the Cambrian animals, but it is difficult to deny that there exists some connection between them and the succeeding Silurian beings, and between the last and the Devonian, and so on. The examination of the primordial fossils leads me to admit passages from one species to another, of genera to genera, and families to families; but that to remain within the complete



truth we must add that the actual state of our scientific knowledge will scarcely admit of our going further. The primordial fossils have not hitherto furnished material proof of passages from one class of animals into another. This statement will not surprise naturalists; for the larger number of them scarcely believe in a linear series, commencing at the Monad, and continuing turn by turn under the form of Polypi, of Echinoderm, of Mollusc, of Annelid, of Articulate, of Fish, of Reptile, of Bird, of Mammal, and finishing with Man. For example, although the Mammalia are the most perfect among the Vertebrates, embryology does not show that they have passed through the condition of Fish, Saurians, and Bird. It is very likely that in geological times there has not been simply a single chain, but many concatenations. The animals of different classes seem to have formed at a very early period distinct branches, of which the development has gone on in an independent manner. While supposing that the palæontological history of the world presents to us a series of evolutions, we must admit that there has existed great inequalities in the development of animals. These inequalities do not confirm the idea of a struggle for existence in which victory remained with the strongest or the most favoured; it is sometimes the beings the most favoured and the most perfect in their class that have become extinct the soonest: *Paradoxides* of the Cambrian, *Slimonia* of the Silurian, *Pterichthys* of the Devonian, *Pentremites* of the Carboniferous, *Euchirosaurus* of the Permian, have marked the highest point of divergence to which their type was to obtain; they could not therefore produce new forms; and as the peculiar quality of the larger number of creatures is to change or to die, they became extinct. At the side of these creatures which have been as passage kings, there have been others of which the personality was less decided, creatures of a more mixed nature, representing in the animal world the just medium. Among these we find the types that have had the greatest persistence. Thus in our days certain cosmopolitan forms are found in every country; and these forms one might term 'panchronique,' for they are of every epoch. They have formed as it were a permanent reservoir, from which have issued at each instant of geological time creatures destined to assume a more or less important part. If these various creatures had changed equally rapidly, those that have been transmitted to us from past ages would all now be animals of a high order; there would thus be more animals that eat than beasts to be eaten; and the harmony of the organic world would have long since been broken.

It likewise appears that the earliest forms among the Brachiopoda, as far as our present state of information will carry us, are referable to the genera *Lingulella* and *Discina*, but in rocks somewhat later in age (the middle beds of the Menevian group or Lower Lingula-flags) to those in which *Lingulella* and *Discina* are found, there appears a species of *Orthis* (*O. Hicksi*) which, as far as I am aware, would be the earliest representative of the division *Clistenterata*. Since the appearance of this *Orthis* both divisions have continued to be represented without apparently showing a tendency to pass one into the other. Now although certain genera, such as those above named and a few others, have enjoyed a very considerable geological existence, by far the larger number of the others, such as *Stringocephalus*, *Uncites*, *Porambonites*, *Davidsonia*, &c., made their appearance very suddenly and without any warning, and after a comparatively short time disappeared in a similarly sudden or abrupt manner. They are all possessed of such marked and distinctive internal characters that we cannot, in the present state of our knowledge, trace between them and associated or synchronous genera any satisfactory or direct evidence of their being either modifications of one or the other, or being the result of descent with modifications, although such may be the case, for all we know to the contrary.

Darwin, whose name will ever be held, like those of Newton, Herschel, Harvey, Faraday, Owen, Lyell, as one of the most eminent among the men of science to which this country has given birth, was always most anxious that his views should be tested and worked out in some detail, and in a single group, and in several communications he urged that I should do this with the *Brachiopoda;* for he was himself fully aware of how many problems still remained to be solved before his theory could be finally admitted. In a letter directed to me, and dated the 26th of April, 1861, he says, "I do not know whether you have read my 'Origin of Species.' In that book I have made the remark, which I apprehend will be universally admitted, that as a whole the fauna of any formation is intermediate in character between that of the formation above and below. But several really good judges have remarked to me how desirable it would be that this should be exemplified and worked out in some detail, and with some single group of beings. Now, every one will admit that no one in the world could do this better than you with the Brachiopods. The result might turn out very unfavorable to the views which I hold; if so, so much the better for those who are opposed to me. But I am inclined to suspect that, on the whole, it would be favorable to the notion of descent with modification. I can hardly doubt that many curious points would occur to any one thoroughly instructed on the subject who could consider a group of beings under the point of view of

Further the inequality in evolution is one of the causes of the variety of aspects that the history of the world presents. At all geological epochs, except perhaps at the outset, there have been creatures in the first stage of evolution, others that have reached the second, others the third, and others the highest. It is from these inequalities that has resulted in part the marvellous beauty of nature in all geological times." See also a paper by M. de Rainecourt "Sur quelques observations sur les modifications des éspèces," 'Bull. Soc. géol. France,' 3rd ser., vol. xi, p. 472, 1883.

descent with modification. All those forms which have come down from an ancient period very slightly modified ought, I think, to be omitted; and those forms alone considered which have undergone considerable change at each successive epoch. My fear is whether the Brachiopoda have changed enough. The absolute amount of difference of the forms in such groups at the opposite extremes of time ought to be considered, and how far the early forms are intermediate in character between those which appeared much later in time. The antiquity of a group is not really diminished, as some seem to think, because it has transmitted to the present day closely allied forms. Another point is how far the succession of each genus is unbroken from the first time it appeared to its extinction, with due allowance made for formations poor in fossils. I cannot but think that an important essay (far more important than a hundred literary reviews) might be written by one like yourself, and without very great labour."

In several subsequent letters Darwin reiterated his suggestions; and, although I have not neglected a request coming from so eminent a quarter, I am bound to state that I have found the subject beset with so many apparently inexplicable difficulties that year after year has passed away without my being able to trace, in a satisfactory manner, the descent with modification among the Brachiopoda which the Darwinian doctrine requires.

The imperfection (due, I believe, to our imperfect acquaintance with the subject) in the geological record cannot in many cases be doubted, but we have no right to make capital out of unknown data. We must therefore deal with the facts as we find them, and see how far they will bear upon the subject under examination. It may be quite true that the strata at great distances cannot be positively asserted to be absolutely contemporaneous, although they may contain some of the same animals.

Darwin's tempting and beautiful theory of descent with modification, of which Prof. Huxley is an enthusiastic supporter, is rapidly gaining adherents;[1] it bears a charm that appears to be almost irresistible, and I would be the last person to assert that it may not represent the actual mode of specific development, but it must likewise be frankly admitted that we are at times stopped by a number of questions that seem to plunge the conception into a maze of inexplicable, nay, mysterious difficulties; nor has Darwin himself, as far as I am aware, said how he supposes the first primordial form to have been created.

Tyndall observes, in his admirable Address to the Belfast Meeting of the British Association, "If you ask me whether there exists the least evidence to prove that any form of life can be developed out of matter, without demonstrable antecedent life, my reply is that evidence, considered perfectly conclusive by many, has been adduced; and that were some of us, who have pondered this question, to follow a very common example and accept testimony because it falls in with our belief, we also should eagerly close with the evidence referred to. But there is in the true man of science a wish stronger than the wish to have his beliefs upheld, namely, the wish to have them true; and this stronger

[1] "The Coming of Age of the Origin of Species," 'Nature,' May 6th, 1880.

wish causes him to reject the most plausible support if he has reason to suspect that it is vitiated by error. Those to whom I refer as having studied this question, believing the evidence offered in favour of 'spontaneous generation' to be thus vitiated, cannot accept it. They know full well that the chemist now prepares from inorganic matter a vast array of substances which were some time ago regarded as the sole products of vitality. They are intimately acquainted with the structural power of matter as evinced in the phenomena of crystallisation. They can justify scientifically their belief in potency, under proper conditions, to produce organisms; but in reply to your question they will frankly admit their inability to point to any satisfactory experimental proof that life can be developed save from demonstrable antecedent life." Further on he adds, "In fact the whole process of evolution is the manifestation of a Power absolutely inscrutable to the intellect of man."

Again, as mentioned by Gaudry,[1] d'Omalius d'Halloy wrote, at the end of his life, "I have difficulty in believing that the Almighty Being, whom I consider the author of Nature, should have at different epochs destroyed all living beings in order to enjoy the pleasure of re-creating new ones, which, on the same general plans, presented successive differences tending to culminate in the present living forms."[2] This language, adds Gaudry, seems to him to be that of common sense, and would be so likewise, I think, to every sensible thinker.

It is probable that at least a large proportion, if not all, of so-termed species may be nothing more than modification of shapes by descent of a limited number of primordial types; but it is very difficult in the present state of our information to show the passages between the genera among the Brachiopoda, as well as among other groups of animals, which the theory of evolution absolutely requires.

In 1873 the late Sir Wyville Thompson said, "I do not think I am speaking too strongly when I say that there is now scarcely a single competent general naturalist who is not prepared to accept some form of the doctrine of evolution."[3] In this statement I willingly concur.

For argument sake, let us take my Tables of Genera[4] as a starting-point, and it will be seen that out of 139 genera therein provisionally recorded some 106 made their first appearance during the Palæozoic period, 34 genera occur in the Mesozoic, 21 in the Cainozoic and Recent periods. Out of these 139 genera 5 only of the Primary or Palæozoic, as far as we have ascertained, have continued to be represented during nearly the whole geological sequence, namely, *Lingula*, *Discina*, *Crania*, *Waldheimia*, and *Rhynchonella*.

[1] "Les Enchainements du Monde Animal dans les Temps géologiques; Fossiles Primaires," p. 291, 1883; and 'Geol. Mag.,' new series, decade iii, vol. i, p. 34, 1884.

[2] D'Omalius d'Halloy, "Sur le transformisme" ('Bull. de l'Acad. Royale de Bruxelles,' 2nd ser., vol. xxxvi, No. 12, Dec., 1873.

[3] 'The Depths of the Sea,' p. 9, 1873.

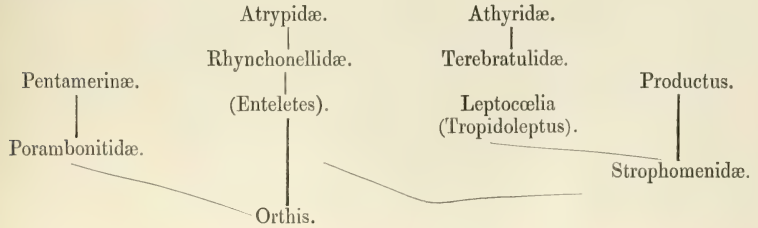
[4] See Tables, pp. 351, 353—357.

Palæozoic ..... 106 genera.	8 in Cambrian (Lower, of Sedgwick)	Of these 106 genera, 11 passed from the Palæozoic into the Mesozoic, 40 became, as far as we at present know, extinct during the Silurian period, 27 passed into the Devonian.
	67 in Silurian (Lower and Upper, of Murchison).	
	52 in Devonian	
	40 in Carboniferous	
	20 in Permian	
Mesozoic ..... 34 genera.	15 in the Triassic	Of these 34 genera, 16 are peculiar to the Mesozoic, 12 passed from the Cainozoic.
	13 in the Rhætic	
	19 in the Jurassic.....	
	18 in the Cretaceous.....	
Cainozoic and Recent. 21 genera.	13 in the Tertiary	Of these 21 genera, 12 passed from the Tertiary into the Recent period.
	20 in the Recent	

Of course the above numbers must be taken as strictly provisional, for some palæontologists would admit a larger number of genera than I have done. Still, the general inductions would not, I think, be materially altered. Of the 34 genera of *Lyopomata* or *Tretenterata* 31 occur in the Palæozoic rocks. Of these, 24 appear to have become extinct during the *Silurian* period, 6 only being represented during the *Mesozoic* and *Cainozoic* periods, 4 only during the Recent period.

Of the *Arthropomata* or *Clistenterata* 76 genera are represented during the Palæozoic period, 37 in the *Mesozoic, Cainozoic,* and *Recent* periods. These details will be better understood by a glance at the tables on pages 351 and 353—357.

Dr. Waagen writes me that in the Third Part of his 'Monograph on the Salt-Range Brachiopoda,' now in the press, he states that the classification of the *Arthropomata* or *Clistenterata*, he thinks, should commence with *Orthis*, as it is the oldest genus of the division at present known; and he has drawn up the following scheme, which he believes might perhaps serve as a base of a more rational classification of the Brachiopoda, although he confesses that it is quite of a provisional nature. This scheme seems to him to express the approximating affinities that exist among the greater part of the *Arthropomata*.



The subject will, however, demand much further consideration, for the passage between the loop-bearing *Terebratulidæ* and the spiral-bearing *Spiriferidæ* has not yet

been discovered, and the same may be said with respect to several of the other genera and even families.

A recapitulation will now be given of the results obtained in connection with British fossil Brachiopoda, and especially so since the commencement of the publication of this Monograph in 1850.

In 1835 I began collecting Scottish Brachiopoda, and during many subsequent years devoted much time to exploring the fossiliferous rocks in different parts of Great Britain as well as of the Continent of Europe. I spared no effort in making myself acquainted with all the works and papers in which British and foreign Brachiopoda had been described, both before and during the preparation of my Monograph for the Palæontographical Society.

In 1843 Prof. J. Morris issued the first edition of his ' Catalogue of British Fossils.' In it he mentioned 13 genera and 454 species of Brachiopoda, but of these a certain number are synonyms. In the second enlarged edition of the same work, published in 1854, he admitted 18 genera and some 652 species, this last edition including all the species I had described up to 1853.

As my Monograph proceeded a large number of new forms were discovered, described, and figured by myself and by others, so that up to the present time some 74 genera, 887 so-termed species, and 89 named varieties or variations in form of some of the species have been described and illustrated in my work; but there can be no doubt that with time, when some of the species are better understood, a certain number of them will be found to be synonyms or modifications in shape of some of the others.

No pains have been spared by myself and by those who have assisted in the assembling of the material described in this work. My regret is that I had to deal with material coming in during all the time I have been engaged on the Monograph, thus obliging me to go over the same subject at different periods, and which would not have been the case if all the material could have been studied previously to commencing the Monograph, in which case repetitions and alterations in views would have been avoided.

Of these 74 British genera 15 are referable to the *Tretenterata*, 59 to the *Clistenterata*.

TRETENTERATA.

1. Acrotreta, *Kutorga*.
2. Acrothele, *Linnarsson*.
3. Crania, *Retzius*.
4. Discina, *Lamarck*.
5. Dinobolus, *Hall*.
6. Kutorgina, *Billings*.
7. Lingula, *Bruguière*.
8. Lingulella, *Salter*.
9. Obolus, *d'Eichwald*.
10. Obolella, *Billings*.
11. Orbiculoidea, *d'Orb*.
12. Paterula, *Barrande*.
13. Pholidops, *Hall*.
14. Siphonotreta, *Kutorga*.
15. Trematis, *Sharpe*.

CLISTENTERATA.

1. Argiope, *Deslongchamp*.
2. Athyris, *M'Coy*.
3. Atrypa, *Dalman*.
4. Aulacorhynchus, *Dittmar*.
5. Bifida, *Davidson*.
6. Centronella, *Billings*.
7. Cyrtia, *Dalman*.
8. Cyrtina, *Davidson*.
9. Cistella, *Wood*.
10. Camarophoria, *King*.
11. Chonetes, *Fischer*.
12. Dielasma, *King*.

British so-termed species may be fairly said to have been doubled in number since the commencement of the publication of this Monograph. Science is continually on the advance; and I wish all I have done to be considered as more or less provisional, and as an incentive to others to continue researches in the same direction, improving upon the work I have sketched out; for there remains so much still to be found out, matured, and corrected, that the subject will repay any amount of labour bestowed upon it.

Geologists have also been hard at work during the last forty or more years, and have effected many very important improvements and rectifications in the stratigraphy previously known. Many of these will be found embodied in Prof. Morris's valuable

13. Dayia, *Davidson*.
14. Davidsonia, *Bouchard*.
15. Eichwaldia, *Hall*.
16. Kaysaria, *Dav*.
17. Koninckella, *M. Chalmas*.
18. Glassia, *Dav*.
19. Kingina, *Dav*.
20. Leptocœlia, *Hall*.
21. Leptæna, *Dalman*.
22. ? Meristella, *Hall*.
23. Magas, *Sow*.
24. ? Meganteris, *Suess*.
25. Martinia, *M'Coy*.
26. Merista, *Suess*.
27. Meristina, *Hall*.
28. Nucleospira, *Hall*.
29. Orthis, *Dalman*.
30. Orthisina, *d'Orb*.
31. Productus, *Sow*.
32. Porambonetes, *Pander*.
33. Pentamerus, *Sow*.
34. Uncites, *Defrance*.
35. Rensselæria, *Billings*.
36. Reticularia, *M'Coy*.
37. Retzia, *King*.
38. Rhynchopora, *King*.
39. Rhynchonella, *Fischer*.
40. Stringocephalus, *Defrance*.
41. Spirifer, *Sow*.
42. Syringothyris, *Winchell*.
43. Strophomena, *Rafinesque*.
44. Spiriferina, *d'Orbigny*.
45. Streptis, *Dav*.
46. Stricklandinia, *Billings*.
47. Skenidium, *Hall*.
48. Streptorhynchus, *King*.
49. Strophalosia, *King*.
50. Terebratula, *Klein*.
51. Terebratulina, *d'Orb*.
52. Terebratella, *d'Orb*.
53. Thecidium, *Defrance*.
54. Trigonosemus, *Kœnig*.
55. Terebrirostra, *d'Orb*.
56. Triplesia, *Hall*.
57. Whitfieldia, *Dav*.
58. Waldheimia, *King*.
59. Zellania, *Moore*.

In vol. v of the 'Système Silurien de la Bohème,' explanation of pl. 152, M. Barrande proposes a new genus *Paterula* for a small *Discina*-shaped shell with a narrow flat margin. His type is the *Paterula bohemica*, and it closely resembles another small similar-shaped or identical species (?), which I figured and described at p. 210, pl. xvii, figs. 41, 42, of my 'Silurian Supplement' under the name of *Discina (?) balcletchiensis*, from the Llandeilo shales of Balcletchie, in Ayrshire. This small fossil occurs there as well as in Bohemia in immense numbers, and I felt at the time very uncertain whether I was correct while referring it to *Discina*. Unfortunately M. Barrande did not describe his genus or species.

Besides the above-named 74 genera some of our British species have been referred by both British and foreign palæontologists to other genera; but of these the larger number are, I think, synonyms —for instance, *Aulacothyris*, Douvillé, for *Wald. resupinata; Acanthothyris*, d'Orb., for *Rh. spinosa; Actinoconchus*, M'Coy, for *Actin. paradoxus; Brachythyris*, M'Coy, for *Sp. duplicicosta; Cleiothyris*, Phillips, for some *Atrypæ; Dictyothyris*, Douvillé, for *Ter. coarctata; Dicœlosia*, King, for *Orthis biloba; Derbya*, Waagen, for *Streptor. senilis; Eudesia*, King, for *Wald. cardium; Hemithyris*, d'Orb., for *Rhynchonella psittacea; Lyra*, Cumberland, for *T. lyra; Liothyris*, Douv., for *T. carnea; Leptagonia*, M'Coy, for *Stroph. rhomboidales; Macandrevia*, King, for *Waldheimia cranium; Monobolina*, Salter, for *Obolus plumbeus; Megathyris*, d'Orb., for *Argiope; Orbicula* for *Discina; Platistrophia*, King, for *Orthis biforata; Seminula*, M'Coy, for *Rh. pentahedra; Uncinulus*, Bayle, for *Rh. Wilsoni; Zellaria*, Bayle, for *Wald. cornuta*, &c.

Were we to indulge in the system of making genera out of every trifling and unimportant difference the number would become so great that it would not only confuse the subject, but render the study of the Brachiopoda one of repulsive difficulty.

'Geological Chart,' in which the succession of the various stratified rocks is clearly shown.[1] I follow this chart chiefly in the few following details, adding an asterisk to those formations in which British Brachiopoda have been found.

Cainozoic or Tertiary.

Recent (Holocene) ...	Modern deposits.
Pleistocene	*Drift and Glacial beds.
Pliocene	*Mammaliferous or Norwich Crag. *Red Crag. *Suffolk (Coralline) Crag.
Miocene ?	Bovey beds.
Oligocene ? or Upper Eocene	Hampstead beds. Bembridge series. Headon series.
Eocene	*Barton and Upper Bagshot beds. *Bracklesham and Lower Bagshot beds. *London clay and Bognor beds. Woolwich clay and Thanet sands.

Mesozoic or Secondary.

Cretaceous	Maestricht beds, absent in England. *Upper Chalk, with flints. *Lower Chalk and Chalk-marl. *Upper Greensand and Chloritic marl. *Gault.
	*Lower Greensand and Upper Speeton clay. Weald clay. Hastings sand.
Upper Oolite *Portlandian*	Purbeck beds. *Portland rock and sand. *Kimmeridge clay.

[1] In his table Prof. Morris does not include the '*Rhætic*' or *Avicula-contorta* zone in the *Trias* proper, but leaves it as a separate deposit lying between the Upper Trias and the Lower Lias. Lyell, at p. 111 in the 'Student's Elements of Geology,' 1871, considers the 'Rhætic' as the uppermost portion of the Trias. The Rhætic beds, in fact, seem to constitute the passage between the Keuper or New Red Sandstone and the Lower Lias. I merely allude to this point in order to mention that in Great Britain, after much research, only one species of Brachiopod has been hitherto procured from the Rhætic, viz. the *Discina Babeana*, d'Orb. = *D. Townshendi*, Forbes, and that no Brachiopod has been hitherto discovered in the Trias proper in Great Britain. Not a trace of the Muschelkalk has been found, and it is in that deposit abroad where the larger number of Triassic Brachiopoda have been collected.

- **Middle Oolite**
  - *Corallian*
    - *Upper calcareous grit.
    - *Coralline Oolite and Coral-rag.
    - *Lower calcareous grit.
  - *Oxfordian*
    - *Oxford clay.
    - *Kelloway rock.
- **Lower Oolite**
  - *Cornbrash.
  - *Forest-marble and Bradford clay.
  - *Great or Bath Oolite and Stonesfield slate.
  - *Fuller's-earth Oolite.
  - *Inferior Oolite and sands.
- **Lias**
  - *Upper Lias clay and sand.
  - *Marlstone and shale.
  - *Lower Lias clay and limestone.
- **Rhætic**
  - *Rhætic or Penarth beds.
- **Triassic** (*New Red Sandstone*)
  - Variegated Marls or Keuper (Muschelkalk absent in England).
  - Red sandstone or Bunter.

Palæozoic or Primary.

- **Permian**
  - Red sandstone and marl.
  - *Magnesian limestone.
  - *Marl-slate.
  - Lower red sandstone.
- **Carboniferous**
  - *Coal-measures.
  - *Millstone-grit.
  - *Mountain-limestone.
  - *Limestone-shales.
- **Devonian** (*Old Red Sandstone*)
  - *Upper Devonian.
  - *Middle Devonian (limestone).
  - *Lower Devonian.
- **Silurian**
  - *Upper*
    - *Ludlow and Aymestry rocks.
    - *Wenlock limestone and shale.
    - *Woolhope series
      - Denbigh grits.
      - Tarannon shale.
    - *Upper Llandovery (May Hill rocks).
  - *Lower*
    - Lower Llandovery.
    - *Caradoc and Bala rocks.
    - *Llandeilo rocks (Skiddaw and Arenig beds).
- **Cambrian**
  - *Tremadoc beds and Lingula-flags.
  - *Menevian.
  - *Longmynd and Harlech rocks.

Pre-Cambrian	Pebidian. Arvonian. Dimetian.
Laurentian	Laurentian or Lewisian gneiss.

Of British Tretenterata we have 15 genera and about 125 species.

Tertiary	2	genera and	3	species.
Cretaceous	2	„	6	„
Jurassic	3	„	27	„
Rhætic	1	„	1	„
Permian	2	„	3	„
Carboniferous	3	„	12	„
Devonian	3	„	6	„
Silurian	15	„	71	„

Of British Clistenterata we have 59 genera, about 762 species, and about 80 named varieties.

Tertiary	5	genera and	7	species.
Cretaceous	12	„	81	„
Jurassic	11	„	214	„
Permian	9	„	16	„
Carboniferous	17	„	141	„
Devonian	30	„	128	„
Silurian	28	„	195	„

Table showing the approximate number of British species in each geological division.

TRETENTERATA.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
Lingula, Bruguière. One species only seems to pass from the Carboniferous into the Permian; one (*L. squamiformis* = *L. mola*) passes from the Devonian into the Carboniferous	2	2	8	...	1	7	1	26
Lingulella, Salter. All Cambrian and Silurian	...	...	...	...	...	...	...	6
Dinobolus, Hall. All Silurian	...	...	...	...	...	...	...	5
? *Obolus*, Eichwald. 4 species, doubtfully referred to Eichwald's genus. Probably different. All Silurian	...	...	...	...	...	...	...	4
Obolella, Billings. All Silurian	...	...	...	...	...	...	...	4
Kutorgina, Billings. Silurian only	...	...	...	...	...	...	...	1
Discina, Lamarck. One passes from the Devonian into the Carboniferous	1	...	12	1	1	3	4	10
Paterula, Barrande. Silurian only	...	...	...	...	...	...	...	1
Trematis, Sharpe. 3 species, all Silurian	...	...	...	...	...	...	...	3
Acrothele, Linnarsson. Silurian	...	...	...	...	...	...	...	1
Orbiculoidea, d'Orbigny. Silurian	...	...	...	...	...	...	...	1
Crania, Retzius. All apparently characteristic of their formation	...	4	7	...	1	2	1	4
Pholidops, Hall. Silurian	...	...	...	...	...	...	...	1
Acrotreta, Kutorga. Silurian	...	...	...	...	...	...	...	2
Siphonotreta, Kutorga. Silurian	...	...	...	...	...	...	...	3

TABLE OF THE CLISTENTERATA,
Showing the approximate number of British Species in each formation, not including named varieties.
With a British example of each genus.

		Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous	Devonian.	Silurian.
Genera and species with loops	*Terebratula*, Klein.—*T. biplicata*	2	22	59					
	Dielasma, King.—*T. elongata*	...	...	...	...	1	4	3	
	Terebratulina, d'Orb.—*T. caput-serpentis*	2	5	3?					
	Terebratella, d'Orb.—*T. Menardi*	...	8	4					
	Trigonosemus, d'Orb.—*T. elegans*	...	2						
	Terebrirostra, d'Orb.—*T. lyra*	...	1						
	Waldheimia, King.—*W. ornithocephala*	...	12	42	...	...	...	2	2
	Magas, Sow.—*M. pumilus*	...	2						
	Kingina, Dav.—*K. lima*	...	2						
	Argiope, Des.—*A. megatrema*	1	1	1					
	Cistella, Gray.—*C. cistellula*	1	1	...					
	? Meganthyris, Suess.—*M. Vicaryi*	...	...	...	...	...	...	1	
	Zellania, Moore.—*Z. Davidsoni*	...	...	6					
	Stringocephalus, Def.—*St. Burtini*	...	...	...	...	..	...	1	
	Rensselæria, Billings.—*R. stringiceps*	...	...	...	...	...	...	2	
	Centronella, Billings.—*C. virgo*	...	...	...	...	...	..	1	
	Thecidium, Def.—*Th. Moorei*	...	2	14					
Genera and species with spiral appendages	*Spirifera*, Sow.—*Sp. striata*	...	...	...	...	2	25	18	5
	Reticularia, M'Coy.—*R. lineata*	...	..	...	...	...	1	1	
	Spiriferina, d'Orb.—*Sp. Walcotti*	...	...	16	..	2	6	1	?
	Syringothyris, Winchell.—*S. cuspidata*	...	...	...	...	...	4		
	Cyrtia, Dalman.—*C. exporrecta*	...	...	...	...	...	...	1	1
	Cyrtina, Dav.—*C. heteroclita*	...	...	...	...	...	3	4	
	Athyris, M'Coy.—*A. planosulcata*	...	...	...	...	1	10	10	1
	Whitfieldia, Dav.—*W. tumida*	...	...	...	...	...	...	...	1
	Merista, Suess.—*M. scalprum*	...	...	...	...	...	...	1	?
	Bifida, Sow.—*B. lepida*	...	...	...	...	...	...	2	
	Uncites, Def.—*U. gryphus*	...	...	...	...	...	...	1	
	Kayseria, Dav.—*K. lens*	...	...	...	...	...	...	1	
	Nucleospira, Hall.—*N. pisum*	...	...	...	...	...	...	...	2
	Glassia, Dav.—*G. obovata*	...	...	...	...	...	...	1	3
	Zygospira, Hall.—*Z. anticostiensis*	...	...	...	...	...	...	...	1
	? Meristella, Hall.—(Uncertain)	...	...	...	...	...	...	...	5?
	Retzia, King.—*R. radialis*	...	...	...	...	...	4	1	1
	Meristina, Hall.—*M. didyma*	...	...	...	...	...	...	...	2
	Dayia, Dav.—*D. navicula*	...	...	...	...	...	...	...	1
	Atrypa, Dalman.—*D. reticularis*	...	...	...	...	...	...	7	7
	Koninckella, Chalmas.—*K. liasiana*	...	...	3					
	Davidsonia, Bouchard.—*D. Verneuilii*	...	...	...	...	...	...	1	
	Triplesia, Hall.—*T. insularis*	...	...	...	...	...	...	...	8?
	Eichwaldia, Hall.—*E. Capewelli*	...	...	...	...	...	...	...	1
	Leptocœlia, Hall.—*L. hemisphærica*	...	...	...	...	...	...	...	1
	Streptis, Dav.—*S. Grayi*	...	...	...	...	...	...	...	1
	Porambonites, Pander.—*P. intercedens*	...	...	...	...	...	...	...	1
	Rhynchonella, Fischer.—*R. psittacea*	1	23	65	...	...	17	26	34
	Rhynchopora, King.—*R. Youngii*	...	...	..	...	...	1		
	Camarophoria, King.—*C. Schlotheimi*	...	...	...	...	3	7	2	
	Pentamerus, Sow.—*P. Knightii*	...	...	...	...	...	...	2	7
	Stricklandinia, Billings.—*St. lirata*	...	...	...	...	...	...	...	3
	Orthis, Dalman.—*O. elegantula*	...	...	...	...	...	4	12	58
	Skenidium, Hall.—*Sk. Lewisii*	...	...	...	...	...	...	1	3
	Orthisina, d'Orb.—*O. adscendens*	...	...	...	..	...	...	...	1
	Strophomena, Raf.—*St. rhomboidalis*	...	...	...	..	...	1	8	31
	Streptorhynchus, King.—*St. pelargonatus*	..	...	...	...	1	2	5	1
	Leptæna, Sow.—*L. transversalis*	...	...	4?	...	...	...	5	11
	Productus, Sow.—*P. semireticulatus*	...	...	...	...	2	38	3	
	Strophalosia, King.—*St. Goldfussi*	...	...	...	...	3			
	Chonetes, Fischer.—*C. Lagurssiana*	...	...	...	...	1	13	4	3
	Aulacorhynchus, Dittmar.—*A. Davidsoni*	...	...	...	...	...	1		

From these Tables it will be seen how very much more numerous, both generically and specifically, were the Brachiopoda in our British rocks during the Palæozoic period, and likewise how few species we appear to have discovered that pass with certainty from one geological period into another. Many of the species seem also to be restricted to certain zones of the same formation, but I am firmly convinced that when better understood a larger number will be found that have passed the limits, often no doubt, arbitrarily assigned to them by palæontologists, who generally like, if they can do so, to see species restricted to one formation, even one horizon or zone. Of late years it has, however, become apparent, through the valuable researches of Sig. Seguenza and others, that a number of Upper-Tertiary or Pliocene species still live on our sea-bottom. In an announcement made by M. Paul Fischer in the 'Bulletin of the Geological Society of France' for March, 1884, that distinguished French malacological observer, while alluding to a large Pliocene *Dentalium* that had been recently dredged alive at 440 metres in the Atlantic, as well as a species of *Cadulus*, says, "Les faits qui se multiplient depuis quelque temps permettent de supposer qu'un grand nombre de formes réputées fossiles vivent encore dans les grands fonds de la mer, et que, par consequent, les differences entre la faune Pliocène et la faune actuelle sont beaucoup moins sensibles qu'entre la faune Miocène et la faune Pliocène." Thus *Terebratulina caput-serpentis* is well known to occur in the Pliocene of Sicily and in the Crag of England; and, indeed, some Cretaceous specimens of *T. striata* bear so near a resemblance to some Mediterranean variations in form of *T. caput-serpentis* that they are scarcely distinguishable, and several so-termed Recent and Tertiary forms of the genus may have been derived from the Cretaceous type, and are possibly no more than varieties of it. Again, the large recent Japanese *T. Crossi*, Dav., much resembles some specimens of the Cretaceous *Terebratulina Defrancii*, although we may not be able to assert that they are identical.

Terebratula vitrea and its var ? *minor* occur in the Pliocene rocks of Sicily, and are still alive in the surrounding sea-bottoms. We know how near it also resembles some specimens of *Ter. carnea* from the Upper Chalk.

Waldheimia septigera, Lovén, is not a rare species on northern sea-bottoms. It occurs also in the Pliocene rocks of Sicily. It had received from Prof. Seguenza the name of *W. peloritana*, but in a paper entitled "Sull antica distribuzione geographica di talune specie malacologiche viventi,"[1] Seguenza admits that his *W. peloritana* and Lovén's *W. septigera* are one and the same species. The *Terebratula septata* of Philippi is a *Terebratella*, and is both generically and specifically distinct from Lovén's type—*Waldheimia Raphaelis*, Dall, from Japanese waters, seem to be nearly related to *Waldheimia septigera*.

Waldheimia cranium, Müller, occurs both recent and fossil. It is found fossil in the Pliocene rocks of Sicily.

[1] 'Bulletino Malacologico Italiano,' anno iii, 1870.

Wald. lenticularis, Deshayes, for which M. Douvillé has proposed a generic name *Neothyris*, while admitting that its internal characters are similar to those of *Waldheimia*, occurs in New Zealand both recent and fossil.

Megerlea truncata, Linné, is found in the Miocene (?) and Pliocene rocks of Italy, and alive in the Mediterranean and on other sea-bottoms.

Argiope decollata, Chemnitz, is a common fossil in the Tertiary rocks of Italy, and occurs abundantly in the living state in the Mediterranean and elsewhere.

Cistella cistellula, Wood, is a recent and fossil form. It occurs in the Miocene marls at Rometta, in Italy, and in the Pliocene or Crag of England.

C. neapolitana, Scacchi, is a recent Mediterranean shell, and is fossil in the Upper Tertiaries of Italy, Rhodes, Austria, &c.

C. cuneata, Risso, occurs recent and fossil in the same localities together with *C. neapolitana*.

Platydia anomioides, Scacchi, is a far-spread recent form, and occurs in the Upper Tertiaries of Sicily and of Austria.

P. Davidsoni, Deslongchamps, occurs both recent and fossil.

Thecidium mediterraneum, Risso, is an abundant far-spread recent form, and is also common in the Upper Tertiaries of Italy.

Th. Barretti, Woodward, is recent and fossil in the Upper Tertiaries of Jamaica.

Rhynchonella psittacea, Gmelin, is an exceedingly abundant recent form, and has been found fossil in the Red and Norwich Crags of England, also in the Upper Tertiaries of Ireland, Scandinavia, Canada, and the South of Spain, &c.

Rhynchonella sicula, Seguenza, has been obtained recent in the English Channel, and fossil in the Upper Tertiaries of Italy.

Crania anomala occurs recent and fossil.

It is therefore evident that at least seventeen Upper Tertiary species are still living on our sea-bottoms, and it is probable that a larger number will hereafter be found to be common to both the Recent and the Tertiary period.

In his 'Catalogue of the Tertiary Mollusca and Echinodermata of New Zealand,' 1873, Mr. T. W. Hutton mentions as Recent and Tertiary *Waldheimia lenticularis*, *W. patagonica*, *Terebratella cruenta*, *T. rubicunda*, *T. dorsata*, *Magasella Cumingi* *Rhynchonella nigricans*, *Waldheimia flavescens*, and *Terebratella spitzbergensis*, but the only one I have myself seen under both conditions is the *W. lenticularis*.

The subject relating to the passage of one and the same species from one geological period into another is most important, and should be taken up in good earnest by some

competent palæontologists; for I feel certain that what has been found to be the case with reference to the passage of the same species from the Upper Tertiary into the Recent epoch will apply equally so to many species that occur in other consecutive formations. The resemblance, for example, between the recent *Rhynchonella nigricans* and some Cretaceous and Jurassic forms is so great that we are at a loss to define their differences. Some *Lingulæ* and other forms offer the same striking resemblances.

In this Monograph all the so-termed species of British Fossil Brachiopoda that have been discovered up to the end of 1883 have been described and illustrated. I am, however, perfectly certain that much more will require to be done before it will be possible to ascertain with any degree of certainty what is even the approximate numbers of really good British species, what are their synonyms, and what variations in shape, and varieties are assumed by each species. A large number of the so-termed species will, with further study, be found to be linked by transitional or passage forms, provided a sufficient number of specimens be collected and compared; and the subject relating to lateral variation is one which must be minutely and carefully investigated by future palæontologists. The internal details of each species should be sought for, carefully described, and illustrated; and from time to time supplements should be prepared and published in the volumes of the Palæontographical Society until the time has come for the preparation and publication of a new general work on British Fossil Brachiopoda, a work that will be surely needed some years hence.

I have done my best, and am fully aware of the many shortcomings in my work, but must now leave the task to be pursued and accomplished by younger and more able hands.

In order to hope to reach a really comprehensive idea as to the number of good species referable to the same genus as occurring all over the world, some one should take up a large family at a time, assemble all obtainable material, class, describe, and figure all the species side by side, and trace their passages one with the other. Had my life not been so far advanced I would, for example, have liked nothing better than to have prepared a general monograph of all the known *Tretenterata*.

The subject embracing the whole Brachiopoda has become so vast that it is almost hopeless for one person to be able to deal with it in its entirety; but taken in parts it can be easily accomplished, and this would advance our knowledge very considerably. Fifty years, as is justly observed by the Duke of Argyll in his Address to the Geological Society of Edinburgh on the occasion of its fiftieth anniversary in 1883, "is but a fragment of time in the history of many sciences, but is a whole age to ours." We may truly assert that during the last half century has been firmly laid down the

foundation of our knowledge in what relates to the *Brachiopoda*, and we should feel so far satisfied with the results already attained as to be encouraged to prosecute an inquiry which is sure to lead to the most important and satisfactory results.

I now desire to express my grateful thanks to the Rev. Prof. T. Wiltshire, M.A., F.G.S., &c., and to Prof. T. Rupert Jones, F.R.S., F.G.S., &c., for all the great and conscientious trouble they have kindly taken during so many years in revising the sheets of this Monograph. My thanks are also due to Mr. J. E. Adlard, who has printed the whole of my large Monograph for the Palæontographical Society. To all those who have helped me during the last thirty-four years, I again tender my sincerest acknowledgments.

CATALOGUE OF BRITISH FOSSIL BRACHIOPODA.

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
LINGULA *tenuis*, Sow. Dav. Tert. Mon. (vol. i), p. 6, pl. i, fig. 12; and Appendix to vol. i, p. 10, pl. A, figs. 3—5. Tert. Sup. (vol. iv), p. 12, pl. ii, figs. 6—8	...	×							
— *Dumortierei*, Nyst. Dav. Tert. Mon. (vol. i), p. 5, pl. i, figs. 10, 11. Tert. Sup. (vol. iv), p. 13, pl. ii, fig. 9	...	×							
— *truncata*, Sow. Dav. Cret. Mon. (vol. i), p. 6, pl. i, figs. 27, 28, and 31. Dav. Cret. Sup. (vol. iv), p. 21	..	...	×						
— *subovalis*, Dav. Cret. Mon. (vol. i), p. 7, pl. i, figs. 29, 30. Dav. Cret. Sup. (vol. iv), p. 21	...	...	×						
— *ovalis*, Sow. Dav. Ool. Mon. (vol. i), p. 98, pl. xviii, fig. 14. Ool. Sup. (vol. iv), p. 74, pl. ix, figs. 1—9; pl. x, fig. 16[b]; pl. xi, fig. 29; pl. xxix, fig. 22?	...	...	...	×					
— *Craneæ*, Dav. Ool. Mon. Sup. (vol. iv), p. 75, pl. ix, figs. 21, 22?	...	...	...	×					
— *longo-viciensis*, Terquem. Dav. Ool. Sup. (vol. iv), p. 75, pl. ix, figs. 24—26	...	...	...	×					
— *Davidsoni*, Oppel. Dav. Ool. Sup. (vol. iv), p. 76, pl. ix, figs. 23, 23[a]	...	...	...	×					
— *metensis*, Terquem. Dav. Ool. Sup. (vol. iv), p. 77, pl. ix, figs. 27—30	...	...	...	×					
— *Brodiei*, Dav. Ool. Sup. (vol. iv), p. 225, pl. ix, fig. 31	...	...	...	×					
— *Beanii*, Phillips. Dav. Ool. Mon. (vol. i), p. 8, in part *not the figures*. Ool. Sup. (vol. iv), p. 78, pl. ix, figs. 10—14?	...	...	...	×					
— *sacculus*, Dewalque. Dav. Ool. Mon. (vol. i), part, pl. i, fig. 1. Ool. Sup. (vol. iv), p. 79, pl. ix, figs. 15—20; pl. x, fig. 25	...	...	...	×					
— *Credneri*, Geinitz. Dav. Permian Mon. (vol. ii), p. 51, pl. iv, figs. 30, 31; and Carb. Mon. (vol. ii), p. 209, pl. xlviii, figs. 38—40	...	...	...	...	...	×	×		
— *squamiformis*, Phillips. Dav. Carb. Mon. (vol. ii), p. 205, pl. xlix, figs. 1—10. Carb. Sup. (vol. iv), p. 266, pl. xlix, figs. 1—10. Dev. Sup. (vol. v), p. 55 = *L. mola*, Salter. Dav. Dev. Mon., vol. iii, p. 105, pl. xx, fig. 13	...	...	...	...	...	...	×	×	
— ? Dav. Carb. Sup. (vol. iv), p. 267, pl. xxx, fig. 9	...	...	...	...	...	...	×		
— *mytiloides*, Sow. Dav. Carb. Mon. (vol. ii), pp. 207, 268, pl. xlviii, figs. 29—36; pl. liv, figs. 28—31	...	...	...	...	...	...	×		
— *Scotica*, Dav. Carb. Mon. (vol. ii), p. 207, pl. xlviii, figs. 27, 28; and Carb. Sup. (vol. iv), p. 265, pl. xxx, figs. 5—8	...	...	...	...	...	...	×		
— *latior*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 210, pl. xlviii, fig. 37	...	...	..	...	...	...	×		
— *attenuata*, Sow. Dav. Sil. Mon. (vol. iii), p. 44, pl. iii, figs. 18—27. Sil. Sup. (vol. v), p. 206, pl. xvii, figs. 13—19	...	...	...	...	...	...	...	...	×
— *brevis*, Portlock. Dav. Sil. Mon. (vol. iii), p. 50, pl. iii, figs. 34—39. Sil. Sup. (vol. v), p. 207, pl. xvii, figs. 26—30	...	...	...	...	...	...	...	...	×

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
LINGULA *Bechei*, Salter. Dav. Sil. Mon. (vol. iii), p. 44, pl. i, figs. 12, 13	...	...	...	...	...	...	...	...	×
— *Brodieana* (Dav.). *Brodiei* in Sil. Sup. (vol. v), p. 204, pl. xvii, fig. 4	...	...	...	...	...	..	...	...	×
(As the name *Brodiei* had been already given to a Jurassic species, we will alter the name to *Brodieana* for the Silurian species.)									
— *crumena*, Phillips. Dav. Sil. Mon. (vol. iii), p. 40, pl. ii, figs. 1—6	...	...	...	...	...	...	...	...	×
— *curta*, Conrad? Dav. Sil. Mon. (vol. iii), p. 52, pl. iii, fig. 33	...	...	...	...	...	...	...	...	×
— *cornea*, Sow. Dav. Sil. Mon. (vol. iii), p. 46, pl. ii, figs. 28—35	...	...	...	...	...	...	...	...	×
— *Canadensis*, Billings. Dav. Sil. Sup. (vol. v), p. 202, pl. xvii, fig. 1	...	...	...	..	...	...	...	...	×
— *granulata*, Phillips. Dav. Sil. Mon. (vol. iii), p. 36, pl. ii, figs. 15—18. Sil. Sup., p. 207, pl. xvii, figs. 20, 21	...	...	...	...	...	...	...	...	×
— *Hawkei*, Rouault (under the mistaken name of *L. Rouaulti*, Salter). Dav. Sil. Mon. (vol. iii), p. 40, pl. 1, figs. 14—20. *L. Hawkei*, Rou. Dav. Sil. Sup., (vol. iv), p. 363, pl. xl, fig. 21	...	...	...	...	...	...	...	...	×
— *Lewisii*, Sow. Dav. Sil. Mon. (vol. iii), p. 35, pl. iii, figs. 1—6	...	...	...	...	...	...	...	...	×
— *lata*, Sow. Dav. Sil. Mon. (vol. iii), p. 49, pl. iii, figs. 40—44	...	...	...	...	...	...	...	...	×
— *Languissima*, Pander? Dav. Sil. Mon. (vol. iii), p. 51, pl. iii, figs. 28—30	...	...	...	...	.	...	...	...	×
— *Lesueuri*, Rouault. Dav. Sil. Mon. (vol. iii), p. 42, pl. i, figs. 1—11. Sil. Sup. (vol. iv) (Bud. Salt. Mon.), p. 361, pl. xl, figs. 16—20. Sil. Sup. (vol. v), p. 204, pl. xvii, fig. 12	...	...	...	...	...	...	...	...	×
— *minima*, Sow. Dav. Sil. Mon. (vol. iii), p. 48, pl. ii, figs. 36—44	...	...	...	...	...	...	...	...	×
— *Morierei*, Tromelin. Dav. Sil. Mon. (vol. iii), pl. i, fig. 31; and (vol. iv), Bud. Salt. Mon., p. 354, pl. xl, figs. 25, 26	...	...	...	...	...	...	...	...	×
— *obtusa*, Hall? Dav. Sil. Mon. (vol. iii), p. 52, pl. iii, fig. 31	...	...	...	...	...	...	...	...	×
— *parallela*, Phillips. Dav. Sil. Mon. (vol. iii), p. 39, pl. ii, figs. 24—27	...	...	...	...	...	...	...	...	×
— *pygmæa*, Salter. Dav. Sil. Mon. (vol. iii), p. 53, pl. ii, fig. 8	...	...	...	...	...	...	...	...	×
— *Philipi*, Dav. Sil. Sup. (vol. v), p. 206, pl. xvii, fig. 5									
— *quadrata*, d'Eichwald. Dav. Sil. Sup. (vol. v). p. 203, pl. xvii, figs. 2, 3	...	...	...	...	...	...	...	...	×
— *Ramsayi*, Salter. Dav. Sil. Mon. (vol. iii), p. 49, pl. iii, figs. 49—52. Sil. Sup. (vol. v), p. 206, pl. xvii, figs. 6—11	...	...	...	...	...	...	...	...	×
— *Symondsii*, Salter. Dav. Sil. Mon. (vol. iii), p. 45, pl. iii, figs. 7—11. Sil. Sup. (vol. v), pl. xvii, figs. 23, 24	...	...	...	...	...	...	...	...	×
— *striata*, Sow. Dav. Sil. Mon. (vol. iii), p. 45, pl. iii, figs. 45—48	...	...	...	...	...	...	...	...	×
— *squamosa*, Holl. Dav. Sil. Mon. (vol. iii), p. 41, pl. ii, fig. 7	...	...	...	...	...	...	...	...	×

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
LINGULA ? *Salteri*, Dav. Sil. Mon. (vol. iii), p. 53, pl. i, figs. 27—29; Bud.-Salt. Mon. (vol. iv), p. 364, pl. xl, fig. 24	...	...	...	...	...	...	...	...	×
— *Thomsoni*, Dav. Carb. Sup. (vol. iv), p. 266, pl. xxx, fig. 10	...	...	...	...	...	...	×	...	...
— *tenuigranulata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 37, pl. ii, figs. 9—14	...	...	...	...	...	...	...	...	×
LINGULELLA *Davisii*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 56, pl. iv, figs. 1—16	...	...	...	...	...	...	...	...	×
— *ferruginea*, Salter. Dav. Sil. Mon. (vol. iii), p. 336, pl. xlix, figs. 32—35. Sil. Sup. (vol. v), pl. xvii, fig. 35	...	...	...	...	...	...	...	...	×
— *lepis*, Salter. Dav. Sil. Mon. (vol. iii), p. 54, pl. iii, figs. 54—58	...	...	...	...	...	...	...	...	×
— *primæva*, Hicks. Dav. Sil. Sup. (vol. v), p. 208, pl. xvii, figs. 33, 34	...	...	...	...	...	...	...	...	×
— ? *petalon*, Hicks. Dav. Sil. Mon. (vol. iii), p. 337, pl. xlix, fig. 30	...	...	...	...	...	...	...	...	×
— *Nicholsoni*, Callaway. Dav. Sil. Sup. (vol. v), p. 208, pl. xvii, figs. 31, 32	...	...	...	...	...	...	...	...	×
DINOBOLUS *Davidsoni*, Salter (as Obolus). Dav. Sil. Mon. (vol. iii), p. 58, pl. iv, figs. 30—39. Sil. Sup. vol. v, p. 212, pl. xvi, fig. 20	...	...	...	...	...	...	...	...	×
— — var. *transversus*, Salter (as Obolus). Dav. Sil. Mon. (vol. iii), p. 59, pl. v, figs. 1—6	...	...	...	...	...	...	...	...	×
— — var. *Woodwardii*, Salter (as Obolus). Dav. Sil. Mon. (vol. iii), p. 60, pl. v, figs. 7, 8	...	...	...	...	...	...	...	...	×
— ? *Hicksii*, Dav. Sil. Sup. (vol. v), p. 212, pl. xvi, fig. 19	...	...	...	...	...	...	...	...	×
— *Brimonti*, Rouault (under the mistaken name of *Lingula Hawkei*). Dav. Sil. Mon. (vol. iii), p. 41, pl. i, figs. 25, 26; and Bud.-Salt. Mon. (vol. v), p. 365, pl. xl, figs. 22, 23	...	...	...	...	...	...	...	...	×
OBOLELLA *Belti*, Dav. Sil. Mon. (vol. iii), p. 340, pl. l, fig. 15	...	...	...	...	...	...	...	...	×
— *maculata*, Hicks. Dav. Sil. Mon. (vol. iii), p. 341, pl. l, figs. 18—21	...	...	...	...	...	...	...	...	×
— *sagittalis*, Salter. Dav. Sil. Mon. (vol. iii), p. 339, pl. l, figs. 1—14; and Sil. Sup. (vol. v), p. 211, pl. xvi, figs. 25, 26	...	...	...	...	...	...	...	...	×
— *Sabrinæ*, Callaway. Dav. Sil. Sup. (vol. v), p. 211, pl. xvi, figs. 27, 28	...	...	...	...	...	...	...	...	×
OBOLUS ? *Phillipsii*, Holl. Dav. Sil. Mon. (vol. iii), p. 62, pl. iv, figs. 17—19	...	...	...	...	...	...	...	...	×
— ? *plumbeus*, Salter. Dav. Sil. Mon. (vol. iii), pp. 61, 341, pl. iv, figs. 20—27; pl. l, figs. 23, 24	...	...	...	...	...	...	...	...	×
— — ? var. *plicata*, Hicks. Dav. Sil. Mon. (vol. iii), p. 342, pl. l, fig. 22	...	...	...	...	...	...	...	...	×
— ? *Salteri*, Holl. Dav. Sil. Mon. (vol. iii), p. 61, pl. iv, figs. 28, 29	...	...	...	...	...	...	...	...	×
Note.—It is very uncertain whether any of these species are really referable to the genus *Obolus*.									
KUTORGINA *cingulata*, Billings. Dav. Sil. Mon. (vol. iii), p. 342, pl. l, fig. 25. Sil. Sup. (vol. v), p. 212	...	...	...	...	...	...	...	...	×

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
DISCINA *Atlantica*, King. Dav. recent Sup. (vol. iv), p. 2, pl. i, fig. 11	×								
— *fallens*, S. Wood (as *D. lamellosa*). Dav. Tertiary Mon. (vol. i), p. 7, pl. i, fig. 9; and Tertiary Sup. (vol. iv), p. 13, pl. i, fig. 9	...	×							
— *latissima*, Dav. Ool. Sup. (vol. iv), p. 80, pl. x, figs. 16—19; and pl. xi, fig. 30	...	...	...	×					
— *elevata*, Blake. Dav. Ool. Sup. (vol. iv), p. 81, pl. xi, fig. 31	...	...	...	×					
— *Humphresiana*, Sow. Dav. Ool. Mon. (vol. i), p. 10, pl. i, fig. 3; and Ool. Sup. (vol. iv), p. 81, pl. xiii, figs. 17—19	...	...	...	×					
— *reflexa*, Sow. Dav. Ool. Mon. (vol. i), p. 10, pl. x, fig. 8; and Ool. Sup. (vol. iv), p. 82, pl. x, figs. 1—6	...	...	...	×					
— *orbicularis*, Moore. Dav. Ool. Sup. (vol. iv), p. 83, pl. x, figs. 9, 10	...	...	...	×					
— *Gunnii*, Dav. Appendix to Sup. (vol. v), p. 279, pl. xx, fig. 19	...	...	...	×					
— *Davidsoni*, Moore. Dav. Ool. Sup. (vol. iv), p. 84, pl. x, fig. 11	...	...	...	×					
— *Dundriensis*, Moore. Dav. Ool. Sup. (vol. iv), p. 84, pl. x, fig. 13	...	...	...	×					
— ? *Moorei*, Dav. Ool. Sup. (vol. iv), p. 85, pl. x, fig. 14	...	...	...	×					
— *Holdeni*, Tate. Dav. Ool. Sup. (vol. iv), p. 85, pl. x, fig. 12, and pl. xi, fig. 32	...	...	...	×					
— *Etheridgiei*, Dav. Ool. Sup. (vol. iv), p. 86, pl. x, fig. 20	...	...	...	×					
— *annulosa*, Dav. Ool. Sup. (vol. iv), p. 87, pl. x, fig. 15	...	...	...	×					
— *Babeana*, d'Orb. (as *D. Townshendi*, Forbes). Dav. Ool. Mon. (vol. i), p. 7, pl. i, fig. 2; and Triassic Sup. (vol. iv), p. 87, pl. x, figs. 21—24	..	...	...	...	×				
— *Koninckii*, Geinitz. Dav Permian Mon. (vol. ii), p. 50, pl iv, figs. 27—29. Permian Sup. (vol. iv), pl. xxx, fig. 4	...	..	...	...	...	×			
— *Craigii*, Dav. Carb. Sup. (vol. iv), p. 267, pl. xxx, fig. 14	...	...	...	...	...	..	×		
— *nitida*, Phillips. Dav. Carb. Mon. (vol. ii), pp. 197, 268, pl. xlviii, figs. 18—25, pl. liv, fig. 26; and Carb. Sup. (vol. iv), pl. xxx, figs. 12, 13. Dev. Mon. (vol. iii), p. 104, pl. xx, figs. 9, 10	...	..	...	...	...	...	×	×	
— *Davreuxiana*, de Kon. Dav. Carb. Mon. (vol. ii), p. 198, pl. xlviii, figs. 26	...	...	...	...	...	...	×		
— *incerta*, Dav. Bud.-Salt. Mon. (vol. iv), p. 353, pl. xl, fig. 145; Sil. Mon. (vol. iii), p. 67, pl. vii, fig. 13	...	...	...	...	...	...	...	×	?
— *Vicaryi*, Dav. Bud.-Salt. Mon. (vol. iv), p. 353, pl. xl, figs. 11—13	...	...	...	...	...	...	...	×	
— ? *Edgelli*, Dav. Bud.-Salt. Mon. (vol. iv) p. 353	...	...	...	...	...	...	...	×	...
— *Caerfaiensis*, Hicks. Dav. Sil. Sup. (vol. v), p. 209, pl. xvii, figs. 37, 38	...	...	...	...	...	...	...	...	×
— *crassa*, Hall. Dav. Sil. Mon. (vol. iii), p. 69, pl. vi, figs. 6, 7	...	..	...	...	...	...	...	...	×
— *Portlockii*, Geinitz. Dav. Sil. Sup. (vol. v), p. 210, pl. xvii, figs. 39, 40	...	...	...	...	...	...	...	...	×
— *oblongata*, Portlock. Dav. Sil. Mon. (vol. iii), p. 66, pl. vii, figs. 1—9. Sil. Sup. (vol. v), p. 209, pl. xvii, figs. 43—46	...	...	...	...	...	...	...	..	×

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
DISCINA *pileolus*, Hicks. Dav. Sil. Mon. (vol. iii), p. 344, pl. xlix, figs. 41, 42	...	...	...	...	...	...	...	...	×
— *perrugata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 65, pl. v, fig. 19—24. Sil. Sup. (vol. v), p. 210, pl. xvii, fig. 47	...	...	...	...	..	...	.	...	×
— *rugata*, Sow. Dav. Sil. Mon. (vol. iii), p. 63, pl. v, figs. 9—18	...	...	...	...	...	...	...	...	×
— *striata*, Sow. Dav. Sil. Mon. (vol. iii), p. 67, pl. vi, figs. 1—4	...	...	...	...	...	...	...	...	×
— *Verneuili*, Dav. Sil. Mon. (vol. iii), p. 68, pl. vi, fig. 5	...	...	...	...	...	..	...	...	×
TREMATIS (*Discina*) *corona*, Salter. Dav. Sil. Mon. (vol. iii), p. 344, pl. xlix, figs. 43, 44	...	...	...	...	...	...	...	...	×
— *punctata*, Sow. Dav. Sil. Mon. (vol. iii), p. 69, pl. vi, fig. 9	...	...	...	...	...	...	...	...	×
— *siluriana*, Dav. Sil. Mon. (vol. iii), p. 71, pl. vi, fig. 8	...	...	...	...	...	...	...	...	×
PATERULA *Balcletchiensis*, Dav. (as *Discina ? Balcletchiensis*), Dav. Sil. Sup. (vol. v), p. 210, pl. xvii, figs. 41, 42	...	...	...	...	...	...	..	...	×
ACROTHELE *granulata*, Linnarsson? Dav. Sil. Sup. (vol. v), p. xvi, pl. xvi, figs. 29, 30	...	...	...	...	...	...	...	...	×
ORBICULOIDEA *Forbesi*, Dav. Sil. Mon. (vol. iii), p. 73, pl. vii, figs. 14—18	...	..	...	...	...	...	...	...	×
CRANIA *anomala*, Müller. Recent Sup. (vol. iv), p. 2, pl. i, fig. 1	×								
— *parisiensis*, Def. Dav. Cret. Mon. (vol. i), p. 8, pl. i, figs. 1—7. Dav. Cret. Sup. (vol. iv), p. 22	...	...	×						
— *irregularis*, Rœmer? Dav. Cret. Sup. (vol. iv), p. 22. Dav. Cret. Mon. (vol. i), pl. xii, figs. 40, 41	...	...	×						
— *cenomaniensis*, d'Orb.? Dav. Cret. Mon. (vol. i), p. 103, pl. xii, figs. 40, 41 (this is probably the *C. irregularis*, Rœmer, and not d'Orbigny's species)	...	...	×						
— *Ignabergensis*, Retzius. Dav. Cret. Mon. (vol. i), p. 11, pl. i, figs. 8—14, and Dav. Cret. Sup. (vol. iv), p. 22	...	...	×						
— *Moorei*, Dav. Ool. Mon. (vol. i), p. 12, figs. 1—9	...	...	...	×					
— *antiquior*, Jelly. Dav. Col. Mon. (vol. i), p. 11, pl. i, figs. 4—8, and Ool. Sup. (vol. iv), p. 89, pl. ix, figs. 36, 37	...	...	...	×					
— *Saundersii*, Moore. Dav. Ool. Mon. (vol. iv), p. 89, pl. ix, figs. 38, 39	...	...	...	×					
— *canalis*, Moore. Dav. Ool. Sup. (vol. iv), p. 90, pl. ix, figs. 32—35	...	...	...	×					
— *Gumberti*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 90, pl. ix, figs. 40, 41	...	...	...	×					
— *liassiana*, Moore. Dav. Ool. Sup. (vol. iv), p. 91	...	...	...	×					
— *Griffini*, Dav. Ool. Sup. (vol. iv), p. 226, pl. xxix, fig. 23	...	...	...	×					
— *Kirkbyi*, Dav. Perm. Mon. (vol. ii), pp. 49, 270. Carb. Mon., pl. liv, figs. 35—38	...	...	...	...	..	×			
— *quadrata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 194, pl. xlviii, figs. 1—13. Carb. Sup., p. 268	..	...	...	...	...	.	×		

TRETENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Rhætic.	Permian.	Carboniferous.	Devonian.	Silurian.
CRANIA *Ryckholtiana*, De Kon. Dav. Carb. Mon. (vol. ii) p. 195, pl. xlviii, figs. 15, 16, 17? Sil. Sup. (vol. v), *footnote*, p. 216, pl. xvii, fig. 57	...	...	...	...	...	...	×		
— *transversa*, Dav. Bud. Salt. Mon. (vol. iv), p. 352, pl. xl, figs. 9, 10	...	...	...	...	...	...	...	×	
— *Crofti*, Dav. Sil. Sup. (vol. v), p. 215, pl. xvii, figs. 54—56	...	...	...	...	...	...	...	...	×
— *divaricata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 78, pl. viii, figs. 7—12	...	...	...	...	...	...	...	...	×
— ? *Grayii*, Dav. Sil. Mon. (vol. iii), p. 82, pl. viii, figs. 22—24	...	...	...	...	...	...	...	...	×
— *siluriana*, Dav. Sil. Mon. (vol. iii), p. 82, pl. viii, figs. 19, 20. Sil. Sup. (vol. v), p. 215, pl. xvii, figs. 49—53	...	...	...	...	...	...	...	...	×
PHOLIDOPS (*Crania*) *implicatus*, Sow. Dav. Sil. Mon. (vol. iii), p. 80, pl. viii, figs. 13—18. Sil. Sup. (vol. v), p. 216, pl. xvii, fig. 48	...	...	...	...	...	...	...	...	×
ACROTRETA *Nicholsoni*, Dav. Sil. Mon. (vol. iii), p. 343, pl. xlix, figs. 36—40. Sil. Sup. (vol. v), p. 213, pl. xvi, figs. 21—23	...	...	...	...	...	...	...	...	×
— ? *costata*, Dav. Sil. Sup. (vol. v), p. 213, pl. xv, fig. 24	...	...	...	...	...	...	...	...	×
SIPHONOTRETA *anglica*, Morris. Dav. Sil. Mon. (vol. iii), p. 75, pl. viii, fig. 1	...	...	...	...	...	...	...	..	×
— *scotica*, Dav. Sil. Sup. (vol. v), p. 217, pl. xvi, figs. 31—33	...	...	...	...	...	...	...	...	×
— *micula*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 76, pl. viii, figs. 2—6	...	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *grandis*, Blum. Dav. Tert. Mon. (vol. i), p. 16, pl. i, fig. 18; pl. ii, figs. 1—8. Tert. Sup. (vol. iv), p. 15, pl. ii, figs. 1—4	...	×						
— *bisinuata*, Lamarck. Dav. Tert. Mon. (vol. i), p. 19; pl. i, fig. 17 (?). Ap. vol. i, pl. A, fig. 2. Ter. Sup. (vol. iv), p. 14	...	×						
— *arcuata*, A. Rœmer (as *Ter. rugulosa*, Morris). Dav. Cret. Mon. (vol. i), p. 49, pl. iv, fig. 14, and Cret. Sup. (vol. iv), p. 32, pl. ii, fig. 16	..	...	×					
— *squamosa*, Mantell. Dav. Cret. Mon. (vol. i), p. 50, pl. v, figs. 5—11. Cret. Sup. (vol. v), p. 33, pl. ii, fig. 15	...	...	×					
— *capillata*, d'Archiac. Dav. Cret. Mon. (vol. i), p. 46, pl. v, fig. 12. Cret. Sup. (vol. iv), p. 33, pl. vii, fig. 2	...	...	×					
— *biplicata*, Sow. Dav. Cret. Mon. (vol. i), p. 55, pl. vi, figs. 1—42 (only). Cret. Sup. (vol. iv), p. 33, pl. v, figs. 1, 2	...	...	×					
— *Lankasteri*, Walk. Dav. Cret. (vol. i), p. 38								

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *sella*, Sow. Dav. Cret. Mon. (vol. i), p. 59, pl. vii, figs. 4—10. Cret. Sup. (vol. iv), pp. 34, 35	...	...	×					
— — var. *Upwarensis*, Walker. Dav. Cret. Sup. (vol. iv), p. 35, pl. v, figs. 3—10	...	...	×					
— — var. *Tornacensis*, d'Archiac, in part. Dav. Cret. Mon. (vol. i), p. 61, pl. vii, figs. 11—16, and pl. ix, figs. 36, 37	...	...	×					
— *phaseolina*, Lamarck. Dav. Cret. Sup. (vol. iv), p. 36, pl. v, fig. 17	...	...	×					
— *obesa*, Sow. Dav. Cret. Mon. (vol. i), p. 53, pl. v, figs. 13—16. Cret. Sup. (vol. iv), p. 37	...	...	×					
— *sulcifera*, Morris. Dav. Cret. Mon. (vol. i), p. 64, pl. vii, figs. 17—20. Cret. Sup. (vol. iv), p. 37	...	...	×					
— *prælonga*, Sow. Dav. Cret. Mon. (vol. i), p. 58, pl. vii, figs. 1, 2. Cret. Sup. (vol. iv), p. 37, pl. iii, figs. 12, 13	...	...	×					
— *microtrema*, Walker. Dav. Cret. Sup. (vol. iv), p. 37, pl. iii, figs. 18—21	...	...	×					
— *abrupta*, Tate. Dav. Cret. Sup. (vol. iv), p. 17, pl. ii, fig. 17	...	...	×					
— *depressa*, Lamarck. Dav. Cret. Mon. (vol. i), p. 70, pl. ix, figs. 9—24. Cret. Sup. (vol. iv), p. 40, pl. iv, figs. 1—4. Appendix to Sup. (vol. v), pl. xviii, fig. 7	...	...	×					
— — var. *uniplicata*, Walker. Cret. Sup. (vol. iv), p. 40, pl. iv, figs. 2 and 5	...	...	×					
— — var. *cyrta*, Walker. Dav. Cret. Sup. (vol. iv), p. 41, pl. iv, figs. 6, 7	...	...	×					
— — var. *Cantabrigensis*, Walker. Dav. Cret. Sup. (vol. iv), p. 41, pl. iv, figs. 8—10	...	...	×					
— *Robertoni*, d'Arch.? Dav. Cret. Mon. (vol. i), p. 72, pl. ix, fig. 25; and Cret. Sup. (vol. iv), p. 42, pl. v, fig. 26	...	...	×					
— *Moutoniana*, d'Arch. Dav. Cret. Sup. (vol. iv), p. 42, pl. iv, figs. 11—13 App. to Sup. (vol. v), p. 251	...	...	×					
— — var. *Brickhillensis*, W. Keeping. Dav. Appendix to Sup. (vol. v), p. 251, pl. xviii, fig. 8	...	...	×					
— *extensa*, Meyer. Dav. Cret. Sup. (vol. iv), p. 43, pl. v, figs. 22—24	...	...	×					
— *Seeleyii*, Walker. Dav. Cret. Sup. (vol. iv), p. 43, pl. vii, figs. 3, 4	...	...	×					
— *Meyeri*, Walker. Dav. Cret. Sup. (vol. iv), p. 44, pl. iii, figs. 6—8	...	...	×					
— *Dallasi*, Walker. Dav. Cret. Sup. (vol. iv), p. 45, pl. iii, figs. 1—5	...	...	×					
— *semiglobosa*, Sow. Dav. Cret. Sup. (vol. iv), p. 45, pl. viii, figs. 6—18	...	...	×					
— — var. *Hibernica*, Tate. Dav. Cret. Sup. (vol. iv), p. 45, pl. ii, figs. 18—20	...	...	×					
— *carnea*, Sow. Dav. Cret. Mon. (vol. i), p. 67, pl. viii, figs. 1—4. Cret. Sup. (vol. iv), p. 47	...	...	×					
— *ovata*, Sow. Dav. Cret. Mon. (vol. i), p. 47, pl. iv, figs. 6—13, and Cret. Sup. (vol. iv), p. 32, pl. ii, fig. 14	...	...	×					
— *ovoides*, Sow. Dav. Ool. Mon. (vol. i), p. 48, pl. viii, figs. 4, 5 only. Drift Sup. (vol. iv), p. 9, pl i, figs. 12, 13 (14, 15, 16?). Appendix to Sup. (vol. v), p. 243. It is a Cretaceous, not a Jurassic species	...	...	×					

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *maxillata*, Sow. Dav. Ool Mon. (vol. i), p. 50, pl. ix, figs. 1—9. Ool. Sup. (vol. iv), p. 121; and Appendix to Sup. (vol. v), p. 264, pl. xx, fig. 12	...	...	...	×				
— — var. *sub-maxillata*, Morris. Dav. Ool. Mon. (vol. i), p. 51, pl. ix, figs. 10—12. Ool. Sup. (vol. iv), p. 122	...	...	...	×				
— *perovalis*, Sow. Dav. Ool. Mon. (vol. i), p. 51, pl. x, figs. 1—6. Ool. Sup. (vol. iv), p. 122, pl. xvii, fig. 9	...	...	...	×				
— — var. *Kleinii* (not of Lamarck) is *T. linguifera*, Buckman. Dav. Appendix to Sup. (vol. v), p. 260, pl. xix, fig. 1	...	...	...	×				
— — var. *ampla*, Buckman. Dav. Ool. Sup. (vol. iv), pl. xxv, fig. 2 (not 1)	...	...	...	×				
— ? *Suessi*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 119, pl. xiv, figs. 4—6	...	...	...	×				
— ? *Perrieri*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 120, pl. xiv, figs. 1—3	...	...	...	×				
— *Phillipsii*, Morris. Dav. Ool. Mon. (vol. i), p. 53, pl. xi, figs. 6—8, and (vol. i), Appendix A, fig. 14. Ool. Sup. (vol. iv), pl. xvii, figs. 10—17	...	...	...	×				
— — var. *Phillipsiana*, Walker. Dav. Ool. Sup. (vol. iv), p. 156, pl. xvii, fig. 23	...	...	...	×				
— *intermedia*, Sow. Dav. Ool. Mon. (vol. i), p. 52, pl. xi, figs. 1—5; and Ool. Sup. (vol. iv), p. 123, pl. xvii, fig. 12	...	...	...	×				
— — var. *Langtonensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 156, pl. xviii, fig. 14	...	...	...	×				
— *Joassi*, Dav. Ool. Sup. (vol. iv), p. 124, pl. xv, fig. 4								
— *bisuffarcinata*, Zeiten (not Schlotheim?). Dav. Ool. Sup. (vol. iv), p. 124, pl. xv, figs. 1—3	...	...	...	×				
— *insignis*, Schübler. Dav. Ool. Sup. (vol. iv), p. 125, pl. xv, fig. 7	...	...	...	×				
— — var. *Maltonensis*, Oppel (as *T. insignis*). Dav. Ool. Mon. (vol. i), p. 47, pl. xiii, fig. 1; and Ool. Sup. (vol. iv), p. 126, pl. xv, figs. 5, 6	...	...	...	×				
— *Oxoniensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 126, pl. xv, figs. 8, 9	...	...	...	×				
— *ventricosa*, Hartmann (?). Dav. Ool. Sup. (vol. iv), p. 127, pl. xv, figs. 10, 11	...	...	...	×				
— *Buckmani*, Dav. Ool. Mon. (vol. i), p. 44, pl. vii, figs. 15, 16	...	...	...	×				
— — var. *Buckmaniana*, Walker. Dav. Ool. Sup. (vol. iv), p. 156, pl. xix, figs. 14—17	...	..	...	×				
— *trilineata*, Young and Bird. Dav. Ool. Mon. (vol. i), p. 48, pl. viii, figs. 6, 7. Ool. Sup. (vol. iv), p. 128, pl. xvi, figs. 1, 2 (not *T. ovoides*, Sow.)	...	...	...	×				
— *punctata*, Sow. Dav. Ool. Mon. (vol. i), p. 45, pl. vi, figs. 1—10, 12, and 16. Ool. Sup. (vol. iv), p. 130, pl. xvi, figs. 6—8, 11, 12, and var. 9, 10?	...	...	...	×				
— — var. *Edwardsii*, Dav. Ool. Mon. (vol. i), p. 30, pl. vi, figs. 11, 13, 14, 15. Ool. Sup. (vol. iv), p. 131, pl. xvii, fig. 22	...	...	...	×				
— — var. *Radstockiensis*, Dav. Ool. Sup. (vol. iv), p. 131, pl. xvi, figs. 14—18	...	...	...	×				
— — var. *Haresfieldensis*, Dav. Ool. Sup. (vol. iv), p. 132, pl. xvi, figs. 3—5	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *Jauberti*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 133, pl. xvii, fig. 13	...	...	...	×				
— ? *Hudlestoni*, Walker (see *Wald. Hudlestoni*). Dav. Ool. Sup. (vol. iv), p. 133, pl. xvii, figs. 14—16	...	...	...	×				
— *sphæroidalis*, Sow. Dav. Ool. Mon. (vol. i), p. 56, pl. ix, figs. 9—15 and 18 (not 16, 17, 19); and Appendix to (vol. i), pl. A, fig. 16? Ool. Sup. (vol. iv), p. 134, pl. xviii, fig. 15	...	...	...	×				
— *Anglica*, Oppel (see *Wald. Anglica*). Dav. Ool. Mon., Appendix to (vol. i), pl. A, figs. 10—13. Ool. Sup. (vol. iv), p. 135, pl. xxiii, figs. 23—26; and Appendix to Supplements (vol. v), pl. xx, fig. 15	...	...	...	×				
— *globulina*, Dav. Ool. Mon. (vol. i), p. 57, pl. xi, figs. 20, 21. Ool. Sup. (vol. iv), p. 135	...	...	...	×				
— *globata*, Sow. Dav. Ool. Mon. (vol. i), p. 54, pl. xiii, figs. 2, 3 (Sowerby's types), 4?, 5, 6, 7? Ool. Sup. (vol. iv), pp. 135, 149, pl. xvii, figs. 1—3	...	...	...	×				
— sp. Dav. Appendix to Sup. (vol. v), p. 265, pl. xx, fig. 16	...	...	...	×				
— *globata*, var. *Fleischeri*, Oppel. Dav. Ool. Mon. (vol. i), pl. xiii, fig. 7. Appendix to (vol. i), pl. A, fig. 18; and Ool. Sup. (vol. iv), p. 137, pl. xvii, fig. 2, probably 1 likewise	...	...	...	×				
— — var. *Birdlipiensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 150, pl. xvii, figs 18—21	...	...	...	×				
— *Endesei*, Oppel. Dav. Ool. Mon. (as *T. globata*), (vol. i), pl. xiii, fig. 4, and Ool. Sup. (vol. iv), p. 138. pl. xvii, fig. 4	...	...	...	×				
— *Bradfordiensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 150, pl. xvii, fig. 6	...	...	...	×				
— *bullata*, Sow. (see *Waldheimia bullata*). Dav. Ool. Mon. (vol. i), pl. xi, fig. 19 only. Ool. Sup. (vol. iv), p. 138, pl. xvii, fig. 5; pl. xxi, figs. 21, 22	...	...	...	×				
— *Fileyensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 139, pl. xiv, figs. 22—24	...	...	...	×				
— *Ferryi*, E. Desl. Dav. Appendix to Sup. (vol. v), p. 257, pl. xviii, figs. 20, 21 (not Ool. Sup. (vol. iv), p. 139, pl. xvii, figs. 7, 8, which is *T. Hollandæ*, Buckman)	...	...	...	×				
— *Etheridgei*, Dav. Appendix to (vol. i), p. 20, pl. A, figs. 7, 8	...	...	...	×				
— *Wrightii*, Dav. Appendix to (vol. i), p. 21, pl. A, fig. 17. Ool. Sup. (vol. iv), p. 140	...	...	...	×				
— *simplex*, Buckman. Dav. Ool. Mon. (vol. i), p. 48, pl. viii, figs. 1—3. Appendix to Sup. (vol. i), p. 18	...	...	...	×				
— *plicata*, Buckman. Dav. Ool. Mon. (vol. i), p. 60, pl. xii, figs. 1—5	...	...	...	×				
— *fimbria*, Sow. Dav. Ool. Mon. (vol. i), p. 61, pl. xii, figs. 6—12. Ool. Sup. (vol. iv), p. 141, pl. xx, fig. 3	...	...	...	×				
— *Bentleyi*, Dav. Ool. Mon. (vol. i), p. 58, pl. xiii, figs. 9, 10, 11; and Appendix to (vol. iv), p. 19. Ool. Sup. (vol. iv), p. 141	...	...	...	×				
— *galeiformis*, M'Coy (*T. sub-Bentleyi*, Dav.). Ool. Mon. (vol. i), p. 59, pl. xiii, fig. 11, and Appendix to (vol. i), p. 19, pl. A, fig. 15	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *flabellum*, Desl. Dav. Ool. Mon. (vol. i), p. 62, pl. xii, figs. 19—21	...	...	..	×				
— *hemisphærica*, Sow Dav. Ool. Mon. (vol. i), p. 64, pl. xiii, figs. 17, 18. Ool. Sup. (vol. iv), p. 142	...	...	...	×				
— ? *minuta*, Moore. Dav. Ool. Sup. (vol. iv), p. 142, pl. xvii, fig. 11 (not 12)	...	...	...	×				
— *coarctata*, Park. Dav. Ool. Mon. (vol. i), p. 59, pl. xii, figs. 12—15; and Ool. Sup. (vol. iv), p. 143, pl. xiv, figs. 18, 19	...	...	...	×				
— — var. *reticulata*, Sow. Dav. Ool. Sup. (vol. iv), p. 144, pl. xiv, figs. 20, 21, and pl. xxv, fig. 3	...	...	...	×				
— *infra-oolitica*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 145, pl. xviii, figs. 8, 9	...	...	...	×				
— *Stephani*, Dav. Dav. Ool. Sup. (vol. iv), p. 147, pl. xviii, figs. 1—7	...	...	...	×				
— *subsella*, Leymerie. Dav. Ool. Sup. (vol. iv), p. 148, pl. xix, figs. 10—12	...	...	...	×				
— *decipiens*, E. Desl. (as *T. sphæroidalis*). Dav. Ool. (vol. i), pl. xi, figs. 16—18; and Ool. Sup. (vol. iv), p. 151, pl. xx, figs. 4—8	...	...	...	×				
— *Craneæ*, Dav. Ool. Sup. (vol. iv), p. 151, pl. xx, figs. 1, 2. Dav. Appendix to Sup. (vol. v), p. 257	...	...	...	×				
— *Whitakeri*, Walker. Dav. Ool. Sup. (vol. iv), p. 152, pl. xix, figs. 6—9	...	...	...	×				
— *curvifrons*, Oppel. (as *W. carinata*). Dav. Ool. Mon. (vol. i), p. 35, pl. iv, figs. 15, 16. Appendix to (vol. i), pl. A, fig. 17. Ool. Sup. (vol. iv), p. 153, pl. xxiv, fig. 33; and Appendix to Sup. (vol. v), p. 264, pl. xx, fig. 17	...	...	...	×				
— *Boloniensis*, Sauvage et Rigaux. Dav. Ool. Sup. (vol. iv), p. 154, pl. xix, figs. 1, 2. Appendix to Sup. (vol. v), p. 256, pl. xviii, fig. 19	...	...	...	×				
— *Gesneri*, Étalon? Dav. Ool. Sup. (vol. iv), p. 155, pl. xix, figs. 4, 5	...	...	...	×				
— *Walfordi*, Dav. Ool. Sup. (vol. iv), p. 156, pl. xix, figs. 18, 19	...	...	...	×				
— *Morierei*, E. Desl. Dav. Appendix to Sup. (vol. v), p. 253, pl. xviii, fig. 11	...	...	...	×				
— *hybrida*, Desl.. Dav. Appendix to Sup. (vol. v), p. 254, pl. xviii, fig. 12	...	...	...	×				
— ? sp. Perhaps not a Brachiopod. Appendix to Sup. (vol. v), p. 264, pl. xviii, fig. 13	...	...	...	×				
— *Eudesiana*, S. Buckman. Dav. Appendix to Sup. (vol. v), p. 255, pl. xviii, fig. 18	...	...	...	×				
— *Tawneyi*, Whidborne. Dav. Appendix to Sup. (vol. v), p. 255, pl. xviii, fig. 14	...	...	...	×				
— *provincialis*, E. Desl. Dav. Appendix to Sup. (vol. v), p. 260, pl. xix, fig. 5	...	...	...	×				
— *Sherbornensis*, S. Buck. Dav. Appendix to Sup. (vol. v), p. 261, pl. xix, fig. 5	...	...	...	×				
— ? sp. Dav. Ool. Sup., pl. xvii, figs. 1—3; and Appendix to Sup. (vol. v), p. 262, pl. xix, fig. 4	...	...	...	×				
— *Hollandæ*, S. Buckman (under the incorrect name of *T. Ferryi*). Dav. Ool. Sup. (vol. iv), p. 139, pl. xvii, figs. 7, 8. Dav. Appendix to Sup. (vol. v), p. 258, pl. xviii, fig. 22	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULA *curviconcha*, Oppel. Dav. Appendix to Sup. (vol. v), p. 256, pl. xviii, fig. 15	...	...	...	×				
— *Leesii*, S. Buckman. Dav. Appendix to Sup. (vol. v), p. 258, pl. xviii, fig. 16	...	...	...	×				
— *Cortonensis*, S. Buck. Dav. Appendix to Sup. (vol. v), p. 259, pl. xix, fig. 3	...	...	...	×				
— *linguifera*, S. Buck. Dav. Appendix to Sup. (vol. v), p. 260, pl. xix, fig. 1	...	...	...	×				
— *gravida*, Szajnocha. Dav. Appendix to Sup. (vol. v), p. 261, pl. xviii, fig. 17	...	...	...	×				
DIELASMA (Tereb.) *elongata*, Schl. Dav. Perm. Mon. (vol. ii), p. 8, pl. i, figs. 5—22; and pl. ii, fig. 2. Dev. Mon. (vol. iii), p. 8, pl. i, fig. 9	...	...	...	...	×	?	×	
— — var. *genuina*, King. Dav. Perm. Mon. (vol. ii), p. 9, pl. i, figs. 5—7, 12—14, and 18—22	...	...	...	...	×			
— — var. *sufflata*, Schl. Dav. Perm. Mon. (vol. ii), p. 10, pl. i, figs. 9—11, 15—17, and 21; pl. ii, fig. 2	...	...	...	...	×			
— (Ter.) *hastata*, Sow. Dav. Carb. Mon. (vol. ii), pp. 11, 213, and 266, pl. i, figs. 1—12	...	...	...	...	...	×		
— — var. *ficus*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 13, pl. i, figs. 13—16	...	...	...	...	...	×	×	
— (Ter.) *sacculus*, Sow. Dav. Carb. Mon. (vol. ii), p. 14, pl. i, figs. 23, 24, 27, 29, 30. Carb. Sup. (vol. iv), p. 269, pl. xxx, fig. 17. Bud. Salt. Mon. (vol. iv), p. 337, pl. xxxviii, figs. 1—3	...	...	...	...	...	×		
— (Ter.) *vesicularis*, de Kon. Dav. Carb. Mon (vol. ii), p. 15, pl. i, figs. 25, 26, 28, 31, 32; pl. ii, figs. 1—8	...	...	...	...	...	×		
— (Ter.) *Gillingensis*, Dav. Carb. Mon. (vol. ii), p. 17, pl. i, figs. 18—20; pl. ii, fig. 1	...	...	...	...	...	×		
— ? (Ter.) *Newtoniensis*, Dav. Dev. Mon. (vol. iii), p. 8, pl. i, figs. 16, 17. Dev. Sup., p. 14, pl. i, fig. 6	...	...	...	...	...	...	×	
— ? *juvenis*, Sow. Dav. Dev. Mon. (vol. iii), p. 8, pl. i, figs. 10—15 (see *Waldheimia juvenis*). Dav. Dev. Sup. (vol. iv), p. 13, pl. i, figs. 1—3	...	...	...	...	...	...	×	
TEREBRATULINA *caput-serpentis*, Linné. Dav. Sup., Recent and Ter. Brach. (vol. iv), p. 3. Tert. Sup. (vol. iv), pp. 9—14, and Dav. Tert. Mon. (vol. i), p. 12, pl. i, figs. 3—6	×	×						
— *striatula*, Sow. Dav. Tert. Mon. (vol. i), p. 14, pl. i, fig. 16. Tert. Sup. (vol. iv), p. 14	...	×						
— *striata*, Sow. Dav. Cret. Mon. (vol. i), p. 35, pl. ii, figs. 18—23 (not 26—28?). Cret. Sup. (vol. iv), p. 29	...	...	×					
— var. *Defrancei*, Dav. Cret. Sup. (vol. iv), p. 30, pl. ii, fig. 13	...	...	×					
— — var. *elongata*, Dav. Cret. Sup. (vol. iv), p. 30	...	...	×					
— *Martiniana*, d'Orb. Dav. Cret. Mon. (vol. i), pl. ii, fig. 26. Cret. Sup. (vol. iv), p. 31	...	...	×					
— *gracilis*, Schl. Dav. Cret. Mon. (vol i), p. 38, pl. ii, figs. 13—15 (not 16, 17). Cret. Sup. (vol. iv), p. 31. Dav. Appendix to Sup. (vol. v), p. 244	...	...	×					
— *rigida*, Sow. Dav. Cret. Mon. (vol. i), pl. ii, figs. 16, 17 (not *T. rigida*, Sow.; see *T. triangularis*, Etheridge). Cret. Sup. (vol. iv), p. 32	...	...	×					

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
TEREBRATULINA *triangularis*, Etheridge. Dav. Appendix to Sup. (vol. v), p. 245, pl. xviii, fig. 3			×					
— *radiata*, Moore. Dav. Ool. Sup. (vol. iv), p. 116, pl. xiv, figs. 7—9				×				
var. *Dundriensis*, Dav. Ool. Sup. (vol. iv), p. 117, pl. xiv, fig. 10				×				
— ? *Deslongchampsii*, Dav. Ool. Sup. (vol. iv), p. 117				×				
— ? *granulosa*, Dav. Ool. Mon. (vol i), p. 18, pl. i, fig. 20. Ool. Sup. (vol. iv), p. 118, pl. xiv, figs. 11, 12				×				
WALDHEIMIA *cranium*, Müller. Dav. Tert. Mon. (vol. i), pl. i, fig. 8 (not fig. 8*a*). Appendix to (vol. i), pl. A, fig. 1. Sup. to Recent and Tert. (vol. iv), p. 3	×							
— *septigera*, Loven. Dav. Recent and Tert. Sup. (vol. iv), p. 4, pl. i, fig. 1	×							
— *Celtica*, Morris. Dav. Cret. Mon. (vol. i), p. 73, pl. ix, figs. 32—35; and Cret. Sup. (vol. iv), p. 47, pl. vi, fig. 15			×					
— *Morrisii*, Mëyer. Dav. Cret. Sup. (vol. iv), p. 47, pl. vii, figs. 10—14			×					
— *pseudo-jurensis*, Leymerie. Dav. Cret. Sup. (vol. iv), p. 48, pl. vii, figs. 10—14			×					
— *tamarindus*, Sow. Dav. Cret. Mon. (vol. i), p. 74, pl. ix, figs. 26—31. Cret. Sup. (vol. iv), p. 49			×					
— var. *magna*, Walker. Dav. Cret. Sup. (vol. iv), p. 49, pl. vi, figs. 16—19; and pl. vii, figs. 5, 9			×					
— ? *Hibernica*, Tate. Dav. Cret. Sup. (vol. iv), p. 50, pl. vii, fig. 21			×					
— *Juddii*, Walker. Dav. Cret. Sup. (vol. iv), p. 50, pl. vii, figs. 15—18			×					
— *Wanklyni*, Walker. Dav. Cret. Sup. (vol. iv), p. 51, pl. vii, figs. 22—28			×					
— *Woodwardi*, Walker. Dav. Cret. Sup. (vol. iv), p. 52, pl. vi, figs. 1—5			×					
— *hippopus*, Roemer; var. *Tilbyensis*, Dav. Cret. Sup. (vol. iv), p. 53, pl. vi, figs. 10, 11			×					
— *Walkeri*, Dav. Cret. Sup. (vol. iv), p. 54, pl. vi, figs. 6—9			×					
— *faba*, d'Orb. (not of Sow.). Dav. Cret. Sup. (vol. iv), p. 55, pl. vi, figs. 12—14			×					
— *Bonneyi*, W. Keeping. Dav. Appendix to Sup. (vol. v), p. 247, pl. xviii, fig. 9			×					
— *quadrifida*, Lam. Dav. Ool. Mon. (vol. i), p. 28, pl. iii, figs. 8—10. Ool. Sup. (vol. iv), p. 157, pl. xxi, fig. 20				×				
— — var. *cornuta*, Sow. Dav. Ool. Mon. (vol. i), p. 29, pl. iii, figs. 11—18. Ool. Sup. (vol. iv), p. 158, pl. xxi, fig. 19				×				
— *Mariæ*, d'Orb. Dav. Ool. Sup. (vol. iv), p. 158, pl. xxi, figs. 16—18				×				
— *indentata*, Sow. Dav. Ool. Mon. (vol. i), p. 46, pl. v, figs. 25, 26. Ool. Sup. (vol. iv), p. 159, pl. xxi, figs. 10—15				×				
— *emarginata*, Sow. Dav. Ool. Mon. (vol. i), p. 35, pl. iv, figs. 18—21; and Ool. Sup. (vol. iv), p. 161, pl. xxiii, figs. 5—7				×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
WALDHEIMIA *Waltoni*, Dav. Ool. Mon. (vol. i), p. 36, pl. v, figs. 1—3, and Ool. Sup. (vol. iv), p. 161, pl. xxiii, figs. 8—10				×				
— *numismalis*, Lamarck. Dav. Ool. Mon. (vol. i), p. 36, pl. v, figs. 4—9. Ool. Sup. (vol. iv), p. 162, pl. xxi, figs. 8, 9				×				
— *sub-numismalis*, Dav. Ool. Mon. (vol. i), p. 38, pl. v, fig. 10. Ool. Sup. (vol. iv), p. 162, pl. xxi, figs. 1—7; and Appendix to Sup. (vol. v), pl. xx, fig. 14				×				
— *Darwini*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 163, pl. xxiv, figs. 9—11				×				
— *perforata*, Piette. Dav. Ool. Sup. (vol. iv), p. 164, pl. xxiv, figs. 1—3 and 5?				×				
— *ornithocephala*, Sow. Dav. Ool. Mon. (vol. i), p. 40, pl. vii, figs. 6—8, 10—13, Ool. Sup. (vol. iv), pp. 165 and 167, pl. xxii, figs. 1, 2, pl. xxiv, fig. 27				×				
— *lagenalis*, Schl. Dav. Ool. Mon. (vol. i), p. 42, pl. vii, figs. 1—4 and 14. Ool. Sup. (vol. iv), p. 168				×				
— *umbonella*, Lam. Dav. Ool. Sup. (vol. iv), p. 168, pl. xxii, figs. 7, 8				×				
— *lampas*, Sow. Dav. Ool. Mon. (vol. iv), p. 169, pl. xxii, figs. 3—6				×				
— *Cadomensis*, E. Desl. Dav. Ool. Mon. (vol. i), pl. vii, fig. 9 (as *C. ornithocephalus*). Ool. Sup. (vol. iv), p. 170, pl. xxii, fig. 9; and pl. xxiv, figs. 14, 15				×				
— *obovata*, Sow. Dav. Ool. Mon. (vol. i), p. 39, pl. v, figs. 14—17, and pl. vii, fig. 5. Ool. Sup. (vol. iv), p. 171, pl. xxii, figs. 10, 11				×				
— — var. *Siddingtonensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 172, pl. xxii, figs. 12—14				×				
— — var. *sub-ovata*, Walker. Dav. Ool. Sup. (vol. iv), p. 172, pl. xxii, figs. 15, 16				×				
— — var. *Stiltonensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 172, pl. xxii, figs. 17—20				×				
— *digona*, Sow. Dav. Ool. Mon. (vol. i), p. 38, pl. v, figs. 18—24, and Ool. Sup. (vol. iv), p. 173, pl. xxii, figs. 21, 22				×				
— *bucculenta*, Dav. Ool. Mon. (vol. i), p. 55, pl. xiii, fig. 8, and Ool. Sup., p. 173, pl. xxii, fig. 23, and pl. xxiv, figs. 23—26				×				
— *Waterhousii*, Dav. Ool. Mon. (vol. i), p. 31, pl. v, figs. 12, 13. Ool. Sup. (vol. iv), p. 174				×				
— *Hughesi*, Walker. Dav. Ool. Sup. (vol. iv), p. 174. Appendix to Sup. (vol. v), p. 267, pl. xviii, figs. 23, 24				×				
— *Lycetti*, Dav. Ool. Mon. (vol. i), p. 44, pl. vii, figs. 17—22, and Ool. Sup. (vol. iv), p. 175, pl. xxiv, figs. 30, 31				×				
— *Dorsetensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 176, pl. xxiv, figs. 6—8				×				
— *margarita*, Oppel. Dav. Ool. Sup. (vol. iv), p. 176, pl. xxiv, figs. 12, 13				×				
— *resupinata*, Sow. Dav. Ool. Mon. (vol. i), p. 31, pl. iv, figs. 1—5. Ool. Sup. (vol. iv), p. 177				×				
— *florella*, d'Orb. Dav. Ool. Sup. (vol. iv), p. 178, pl. xxiii, figs. 11—13				×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
WALDHEIMIA *Moorei*, Dav. Ool. Mon. (vol. i), p. 33, pl. iv, figs. 6, 7. Ool. Sup. (vol. iv), p. 179	...	...	...	×				
— *Bakeriæ*, Dav. Ool. Mon. (vol. i), p. 38, pl. v, fig. 11. Ool. Sup. (vol. iv), p. 179	...	...	...	×				
— *carinata*, Lam. Dav. Ool. Mon. (vol. i), p. 35, pl. iv, figs. 11—14 (not 15—17). Ool. Sup. (vol. iv), p. 179, pl. xxiii, figs. 14, 15	...	...	...	×				
— — var. *Mandelslohi*, Oppel. Dav. Ool. Sup. (vol. iv), p. 180, pl. xxiii, figs. 16—18	...	...	...	×				
— — var. *Blakei*, Walker. Dav. Ool. Sup. (vol. iv), p. 181, pl. xxiii, figs. 19, 20	...	...	...	×				
— — var. *Crewkerniensis*, S. Buckman. Dav. Appendix to Sup. (vol. v), p. 268, pl. xix, fig. 8	...	...	...	×				
— *Meriani*, Op. (as *T. impressa*, pars.) Ool. Mon. (vol. i), p. 33, pl. iv, fig. 8, pl. x, fig. 7; (vol. iv), p. 181	...	...	...	×				
— *impressa*, Von Buch. Dav. Ool. Mon. (vol. i), p. 33, pl. iv, fig. 9, 10 (not 8). Ool. Sup. (vol. iv), p. 182, pl. xxiv, fig. 32	...	...	...	×				
— *Leckenbyi*, Walker. Dav. Ool. Mon. Appendix to (vol. i), pl. A, fig. 19 (as *W. submaxillata*). Ool. Sup. (vol. iv), p. 183, pl. xxiii, figs. 1—4	...	...	...	×				
— ? *humeralis*, Roemer. Dav. Ool. Sup. (vol. iv), p. 183, pl. xxiv, figs. 18, 19	...	...	...	×				
— sp. Dav. Ool. Sup. (vol. iv), p. 185, pl. xxiv, fig. 20.	...	...	...					
— *cardium*, Lam. Dav. Ool. Mon. (vol. i), p. 43, pl. xii, figs. 13—18. Ool. Sup. (vol. iv), p. 185, pl. xxiv, figs. 21, 22	...	...	...	×				
— *Anglica* (Tereb.?), Oppel. Dav. Ool. Sup. (vol. iv), pp. 135, 186, pl. xxiii, figs. 23—26; and Appendix to Sup. (vol. v), p. 270, pl. xx, fig. 15	...	...	...	×				
— *Huddlestoni*, Walker. Dav. Ool. Sup. (vol. iv), pp. 135, 186, pl. xvii, figs. 14—16	...	...	...	×				
— *bullata*, Sow. Dav. Ool. Sup. (vol. iv), p. 187, pl. xxi, figs. 21, 22	...	...	...	×				
— *Haasi*, S. Buck. Dav. Appendix to Sup. (vol. v), p. 265, pl. xix, figs. 11, 12	...	...	...	×				
— *Brodiei*, S. Buck. Dav. Appendix to Sup. (vol. v), p. 266, pl. xix, figs. 14, 15	...	...	...	×				
— *disculus*, Waagen. Dav. Appendix to Sup. (vol. v), p. 266, pl. xix, fig. 17	...	...	...	×				
— *reversa*, S. Buckman. Dav. App. to Sup. (vol. v), p. 267, pl. xix, fig. 13, and pl. xx, fig. 13	...	...	...	×				
— *bisulcata*, S. Buck. Dav. App. to Sup. (vol. v), p. 268, pl. xix, figs. 9, 10	...	...	...	×				
— *cor*, Lamarck? Dav. App. to Sup. (vol. v), p. 269, pl. xix, fig. 16	...	...	...	×				
— *juvenis*, Sow. (as Terebratula). Dav. Dev. Mon. (vol. iii), p. 8, pl. i, figs. 10—15, and Dev. Sup. (vol. v), p. 13, pl. i, figs. 1, 2	...	...	...	...	...	...	×	
— ? sp. Dav. Dev. Sup. (vol. v), p. 13, pl. i, fig. 5	...	...	...	...	...	...	×	
— ? *Whidbornei*, Dav. (*Ter. sacculus*, Dav., not of Martin). Dev. Mon. (vol. iii), p. 6, pl. i, figs. 1—8. Dev. Sup. (vol. v), p. 12, pl. i, figs. 3, 4	...	...	...	...	...	...	×	
— *bicarinata*, Angelin = Wald. *Mawei*, Dav. Sil. Sup. (vol. v), p. 76, pl. iv, figs. 1—3	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
WALDHEIMIA ? *Glassii*, Dav. Sil. Sup. (vol. v), p. 77, pl. iv, fig. 4	...	...	...	...	...	...	...	×
TEREBRATELLA *Spitzbergensis*, Dav. Sup. to British Recent Species (vol. iv), p. 4, pl. i, fig. 2	×							
— *Menardi*, Lam. Dav. Cret. Mon. (vol. i), p. 24, pl. iii, figs. 34—42; and Cret. Sup. (vol. iv), p. 24, pl. viii, fig. 14. Appendix to Sup. (vol. v), p. 247, pl. xviii, fig. 6	...	...	×					
— *truncata*, Sow. Dav. Cret. Mon. (vol. i), p. 25, pl. iii, figs. 34—41. Cret. Sup. (vol. iv), p. 25 ...	...	...	×					
— *trifida*, Mëyer. Dav. Cret. Sup. (vol. iv), p. 25, pl. viii, figs. 15—17	...	...	×					
— *pectita*, Sow. Dav. Cret. Mon. (vol. i), p. 26, pl. iii, figs. 29—33. Cret. Sup. (vol. iv), p. 25	...	...	×					
— *oblonga*, Sow. Dav. Cret. Mon. (vol. i), p. 51, pl. ii, figs. 29—32. Sup. (vol. iv), p. 26	...	...	×					
— *Fittoni*, Meyer. Dav. Cret. Sup. (vol. iv), p. 26, pl. viii, figs. 8—13	...	...	×					
— *Davidsoni*, Walker. Dav. Cret. Sup. (vol. iv), p. 27, pl. viii, figs. 1—7	...	...	×					
— *Keepingii*, Walker. Dav. Appendix to Sup. (vol. v), p. 245, pl. xviii, figs. 4, 5	...	...	×					
— *Buckmani*, Moore. Dav. Ool Sup. (vol. iv), p. 114, pl. xiv, figs. 13, 14	...	...	...	×				
— *furcata*, Sow. Dav. Ool. Mon. (vol. iv), p. 115, pl. xiv, figs. 15, 16	...	...	...	×				
— *Moorei*, Dav. Ool. Sup. (vol. iv), p. 115, pl. xiv, fig. 17	...	...	...	×				
— ? *liasiana*, Desl. Dav. Ool. Sup. (vol. iv), p. 116	...	...	...	×				
TRIGONOSEMUS *elegans*, Kœnig. Dav. Cret. Mon. (vol. i), p. 29, pl. iv, figs. 1—4. Cret. Sup. (vol. iv), p. 28	...	...	×					
— *incertus*, Dav. Cret. Mon. (vol. i), p. 31, pl. iv, fig. 5. Cret. Sup. (vol. iv), p. 28	...	...	×					
TEREBRIROSTRA *lyra*, Sow. sp. Dav. Cret. Mon. (vol. i), p. 32, pl. iii, figs. 17—28. Cret. Sup. (vol. iv), p. 28. Appendix to Sup. (vol. v), p. 243, pl. xviii, figs. 1, 2 ...	...	...	×					
MAGAS *pumilus* (Sow.). Dav. Cret. Mon. (vol. i), p. 19, pl. ii, figs. 1—12 and 33	...	...	×					
— ? *Geinitzii*, Schloenbach. Dav. Cret. Sup. (vol. iv), p. 24	...	...	×					
KINGENA *lima*, d'Orb. Dav. Cret. Mon. (vol. i), p. 42, pl. iv, figs. 15—28; and pl. v, figs. 1—4. Cret. Sup. (vol. iv), p. 28	...	...	×					
—? *rhomboidalis*, W. Keeping. Dav. Appendix to Sup. (vol. v), p. 246, pl. xviii, fig. 10	...	...	×					
ARGIOPE *decollata*, Chemnitz. Dav. Recent. Sup. (vol. iv), p. 7, pl. i, figs. 5, 6	×							
— *megatrema*, Sow. Dav. Cret. Mon. (vol. i), p. 101, pl. xii, figs. 31, 32, 34—36 ? and Cret. Sup. (vol. iv), p. 23	...	...	×					
— ? *oolitica*, Dav. Ool. Sup. (vol. iv), p. 111, pl. xi, fig. 16 ...				×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
CISTELLA (Argiope) *cistellula*, S. Wood. Dav. Recent and Tertiary Sup. (vol. iv), p. 6, pl. i, fig. 2; and Tertiary Mon. (vol. i), p. 10, pl. i, fig. 13	×	×						
— (Argiope) *Bronnii*, von Hag. Dav. Cret. Mon. (vol. i), p. 102, pl. iii, figs. 1—13; and pl. xii, figs. 37, 38. Cret. Sup. (vol. iv), p. 23	...	...	×					
ZELLANIA *Davidsoni*, Moore. Dav. Ool. Sup. (vol. iv), p. 112, pl. xi, figs. 18, 19	...	...	...	×				
— *Laboucherei*, Moore. Dav. Ool. Sup. (vol. iv), p. 112, pl. xi, figs. 20, 21	...	...	...	×				
— *liasiana*, Moore. Dav. Ool. Sup. (vol. iv), p. 112, pl. xi, figs. 23, 24	...	...	...	×				
— *globata*, Moore. Dav. Ool. Sup. (vol. iv), p. 113, pl. xi, figs. 25—27	...	...	...	×				
— *oolitica*, Moore. Dav. Ool. Sup. (vol. iv), p. 113, pl. xi, fig. 28	...	...	...	×				
— *obesa*, Moore. Dav. Ool. Sup. (vol. iv), p. 114, pl. xi, fig. 22	...	...	...	×				
STRINGOCEPHALUS *Burtini*, Def. Dav. Dev. Mon. (vol. iii), p. 11, pl. i, figs. 18—22; pl. ii, figs. 1—11. Dev. Sup. (vol. v), p. 19, pl. iii, figs. 2, 3	...	...	...	...	...	...	×	
MEGANTHYRIS ? *Vicaryi*, Dav. Dev. Mon. (vol. iii), pl. xx, fig. 15. Dev. Sup. (vol. v), p. 20, pl. iii, fig 1	...	...	...	...	...	...	×	
RENSSELÆRIA *stringiceps?* F. Roemer. Dav. Dev. Mon. (vol. iii), p. 10, pl. iv, figs. 5—7	...	...	...	...	...	...	×	
— ? *striatissima*, Dav. Dev. Sup. (vol. v), p. 19, pl. i, fig. 20	...	...	...	...	...	...	×	
CENTRONELLA *virgo*, Phillips sp. Dav. Dev. Sup. (vol. v), p. 14, pl. i, figs. 7—9	...	...	...	...	...	...	×	
THECIDIUM *Faringdonense*, Meyer. Dav. Cret. Sup. (vol. iv), p. 23, pl. ii, figs. 11, 12	...	...	×					
— *Wetherelli*, Morris. Dav. Cret. Mon. (vol. i), p. 14, pl. i, figs. 15—26, not xii, fig. 39. Dav. Cret. Sup. (vol. iv), p. 22	...	...	×					
— *ornatum*, Moore. Dav. Ool. Sup. (vol. iv), p. 104, pl. xiii, figs. 5—9	...	...	...	×				
— ? *pygmæum*, Moore. Dav. Ool. Sup. (vol. iv), p. 105, pl. xiii, fig. 16	...	...	...	×				
— *Moorei*, Dav. Ool. Mon. (vol. i), p. 13, pl. i, fig. 10; and Ool. Sup. (vol. iv), p. 105	...	...	...	×				
— *Bouchardii*, Dav. Ool. Mon. (vol. i), p. 14, pl. i, figs. 15, 16. Ool. Sup. (vol. iv), p. 106, pl. xiii, figs. 1—3	...	...	...	×				
— *Dickinsoni*, Moore. Dav. Ool. Mon. (vol. i), p. 14, pl. xiii, fig. 19. Ool. Sup. (vol. iv), p. 106	...	...	...	×				
— *triangulare*, d'Orb. Dav. Ool. Mon. (vol. i), p. 14, pl. i, figs. 11, 12, and Ool. Sup. (vol. iv), p. 106, pl. xii, figs. 25, 26	...	...	...	×				
— *rusticum*, Moore. Dav. Ool. Mon. (vol. i), p. 15, pl. i, fig. 14; and Ool. Sup., p. 107, pl. xiii, fig. 10	...	...	...	×				
— *sub-serratum*, Tate. Dav. Ool. Sup. (vol. iv), p. 107, pl. xiii, figs. 11—13	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
THECIDIUM *Deslongchampsii*, Dav. Appendix to vol. i, p. 14, pl. A, fig. 6	...	...	...	×				
— *duplicatum*, Moore. Dav. Appendix to vol. i, p. 30. Ool. Sup., p. 108, pl. xii, figs. 15—20	...	...	...	×				
— *serratum*, Moore. Appendix to vol. i, p. 30; and Ool. Sup. (vol. iv), p. 108, pl. xii, figs. 10—14	...	...	...	×				
— *septatum*, Moore. Dav. Appendix to vol. i, p. 30; and Ool. Sup. (vol. iv), p. 109, pl. xii, figs. 22—24	...	...	...	×				
— *Forbesi*, Moore. Dav. Ool. Sup. (vol. iv), p. 109, pl. xii, figs. 6—9	...	...	...	×				
— ? *granulosum*, Moore. Dav. Ool. Sup. (vol. iv), p. 110, pl. xii, figs. 1—5	...	...	...	×				
SPIRIFERA *alata*, Schl. Dav. Perm. Mon. (vol. ii), p. 13, pl. i, figs. 23—36; and pl. ii, figs. 6, 7	...	...	...	...	×			
— *Clannyana*, King. Dav. Perm. Mon. (vol. ii), p. 15, pl. i, figs. 47—49. Dav. Perm. Sup. (vol. v, p. 15, pl. i, figs. 47—49	...	...	...	...	×			
— *striata*, Martin. Dav. Carb. Mon. (vol. ii), pp. 19, 221, pl. ii, figs. 12—21; pl. iii, figs. 2—6; and Carb. Sup. (vol. iv), p. 274, pl. xxxi, xxxii, and xxxiv	...	...	...	...	...	×		
— *id.*, under the mistaken name of *Sp. mosquensis*. Dav. Carb. Mon. (vol. ii), p. 22, pl. iv, figs. 13, 14, and Carb. Sup. (vol. iv), p. 274 (not *Sp. mosquensis*, Fischer, a species that does not occur in Great Britain), as subsequently found to be the case by Prof. L. De Koninck	...	...	...	...	...	×		
— *humerosa*, Phillips. Dav. Carb. Mon. (vol. ii), p. 23, pl. iv, figs. 15, 16	...	...	...	...	...	×		
— *duplicicosta*, Phillips. Dav. Carb. Mon. (vol. ii), pp. 24, 221, pl. iii, figs. 7—10; pl. iv, figs. 3, 5—11; pl. v, figs. 35—37, incorrectly referred to *Sp. trigonalis*	...	...	...	...	...	×		
— *crassa*, De Kon. Dav. Carb. Mon. (vol. ii), p. 25, pl. vi, figs. 20, 22; and pl. vii, figs. 1—3, is a var. of *Sp. trigonalis*, var. *bisulcata*	...	...	...	...	...	×		
— *planata*, Phil. Dav. Carb. Mon. (vol. ii), p. 26, pl. vii, figs. 25—36	...	...	...	...	...	×		
— *triangularis*, Martin. Dav. Carb. Mon. (vol. ii), p. 27, pl. v, figs. 16—24, p. 223; pl. l, figs. 10—18	...	...	...	...	...	×		
— *trigonalis*, Martin. Dav. Carb. Mon. (vol. ii), p. 29, pl. v, figs. 25—34, 35—37 ? p. 222, pl. l, figs. 3—9; and Carb. Sup. (vol. iv), p. 276, pl. xxxiv, figs. 2—5	...	...	...	...	...	×		
— *bisulcata*, Sow. Dav. Carb. Mon. (vol. ii), p. 31, pl. iv, fig. 1 ? pl. v, fig. 1; pl. vi, figs. 1—19; pl. vii, fig. 4. (It is only a variety of *Sp. trigonalis*)	...	...	...	...	...	×		
— *transiens*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 33, pl. iv, fig. 2 (probably a var. of *Sp. bisulcata*)	...	...	...	...	...	×		
— *grandicostata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 33, pl. v, figs. 38, 39; pl. vii, figs. 7—16 (probably also a var. of *Sp. bisulcata*)	...	...	...	...	...	×		
— *convoluta*, Phillips. Dav. Carb. Mon. (vol. ii), p. 35. pl. v, figs. 9—15 (not figs. 2—8), p. 223, pl. l, figs. 1, 2	...	...	...	...	...	×		
— *rhomboidea*, Phillips. Dav. Carb. Mon. (vol. ii), footnote, p. 36; p. 223, pl. v, figs. 2—8	...	...	...	...	...	×		
— *mesogonia*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 48, pl. vii, fig. 24	...	...	...	...	...	×		

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
SPIRIFERA *triradialis*, Phil. Dav. Carb. Mon. (vol. ii), p. 49, pl. ix, figs. 4—12						×		
— *pinguis*, Sow. Dav. Carb. Mon. (vol. ii), p. 50, pl. x, figs. 1—12. Carb. Sup. (vol. iv), p. 274, pl. xxxi and xxxii, including *Sp. rotundata*, Sow., which is the full-grown condition of *Sp. pinguis*						×		
— *ovalis*, Phillips. Dav. Carb. Mon. (vol. ii), p. 53, pl. ix, figs. 20—26						×		
— *integricostata*, Phillips. Dav. Carb. Mon. (vol. ii), p. 55, pl. ix, figs. 13, 19						×		
— *fusiformis*, Phillips. Dav. Carb. Mon. (vol. ii), p. 56, pl. xiii, fig. 15						×		
— (MARTINIA ?) *rhomboidalis*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 57, pl. xii, figs. 6, 7 (is a variety of *Sp. glabra*)						×		
— — ? *Urii*, Fleming. Dav. Carb. Mon. (vol. ii), p. 58, pl. xii, figs. 13, 14. Dav. Dev. Mon. (vol. iii), p. 41, pl. iv, figs. 25—28. Dev. Sup. (vol. v), p. 34					?	×	×	
— — ? *Carlukensis*, Dav. Carb. Mon. (vol. ii), p. 59, pl. xiii, fig. 14; and pl. lv, figs. 14, 15						×		
— — ? *glabra*, Martin. Dav. Carb. Mon. (vol. ii), p. 59, pl. xi, figs. 1—9; pl. xii, figs. 1—5, 11, 12, p. 225. Carb. Sup. (vol. iv), p. 274, pl. xxxii, figs. 3—5						×	×	
— *acuta*, Martin. Dav. Carb. Mon. (vol. ii), p. 224, pl. lii, figs. 6, 7						×		
— *Reedii*, Dav. Carb. Mon. (vol. ii), p. 43, pl. v, figs. 40—47 (doubtful species)						×		
— *minima*, Sow. Dav. Carb. Mon. (vol. ii), p. 40, pl. vii, figs. 56—59						×		
— *canalifera*, Val. = *aperturata*, Schl. Dav. Dev. Mon. (vol. iii), p. 26, pl. vi, fig. 9							×	
— *primæva*, Steininger. Under the incorrect name of *Sp. cultrijugata*, Roemer, in Dav. Dev. Mon. (vol. iii), p. 35, pl. viii, figs. 1—3. Dev. Sup., p. 34							×	
— *curvata*, Schl. Dav. Dev. Mon. (vol. iii), p. 39, pl. iv, figs. 29—32, 33 ? 34 ?; pl. ix, figs. 26, 27. Dev. Sup. (vol. v), p. 32, pl. i, fig. 34, and pl. ii, fig. 4							×	
— *hysterica*, Schl. Dav. Dev. Mon. (vol. iii), p. 34, pl. viii, figs. 16, 17							×	
— *lævicosta*, var.=*ostiolata*, Schl. Dav. Dev. Mon. (vol. iii), p. 28, pl. viii, figs. 4, 5. Dev. Sup. (vol. v), p. 33, pl. ii, figs. 2, 3							×	
— *megaloba ?* Phillips. Dav. Dev. Mon., p. 28, pl. ix, fig. 23							×	
— *mesomala ?* Phil. Dav. Dev. Mon. (vol. iii), p. 27, pl. vi, fig. 8							×	
Newtoniensis, Dav. Dev. Mon. (vol. iii), p. 40, pl. ix, fig. 21							×	
— *nuda*, Sow. Dav. Dev. Mon. (vol. iii), p. 38, pl. iv, figs. 17—24							×	
— *obliterata ?* Phil. Dav. Dev. Mon. (vol. iii), p. 27, pl. vi, fig. 10							×	
— *rudis ?* Phil. Dav. Dev. Mon. (vol. iii), p. 28, pl. ix, figs. 24, 25							×	
— *simplex*, Phil. Dav. Dev. Mon. (vol. iii), p. 46, pl. vi, figs. 18—22							×	

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
SPIRIFERA *speciosa*, Schl. Dav. Dev. Mon. (vol. iii), p. 29, pl. viii, figs. 6—8. Bud. Sal. Mon. (vol. iv), p. 340, pl. xxxviii, figs. 15—18	...	...	...	...	...	...	×	
— *subcuspidata*, Schnur. Dav. Dev. Mon. (vol. iii), p. 33, pl. viii, figs. 14, 15	...	...	...	...	...	...	×	
— *undifera*, F. Roemer. Dav. Dev. Mon. (vol. iii), p. 36, pl. vii, figs. 1—10. Dev. Sup. (vol. v), p. 33, pl. i, fig. 33	...	...	...	...	...	...	×	
— — var. *undulata*, F. Roemer. Dav. Dev. Mon. (vol. iii), p. 37, pl. viii, figs. 11—14	...	...	...	...	...	...	×	
— *Verneuilii*, Murch. (as *Sp. disjuncta*, Sow.). Dav. Dev. Mon. (vol. iii), p. 23, pl. v, figs. 1—12; pl. vi, figs. 1—5; and Dev. Sup. (vol. v), p. 35, pl. ii, fig. 1. Bud. Salt. Mon. (vol. iv), p. 339, pl. xxxviii, figs. 9—14	...	...	...	...	...	...	×	
— *bijugata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 89, pl. x, figs. 1—3	...	...	...	...	...	...	...	×
— *crispa*, Hisinger. Dav. Sil. Mon. (vol. iii), p. 97, pl. x, figs. 13—15. Sil. Sup, (vol. v), pl. iv, figs. 9, 10	...	...	...	...	...	...	...	×
— *elevata*, Dalman. Dav. Sil. Mon. (vol. iii), p. 95, pl. x, figs. 7—11	...	...	...	...	...	...	...	×
— *sulcata*, Hisinger. Dav. Sil. Mon. (vol. iii), p. 91, pl. x, figs. 4—6	...	...	...	...	...	...	...	×
— *plicatella*, var. *radiata*, Sow. Dav. Sil. Mon. (vol. iii), pp. 84—87, pl. ix, figs. 1—6. Sil. Sup. (vol. v), p. 137, pl. vi, figs. 11, 12; and pl. viii, figs. 2, 3	...	...	...	...	...	...	...	×
— — var. *interlineata*, Sow. Dav. Sil. Mon. (part as *Sp. plicatella*), (vol. iii), p. 84, pl. ix, figs. 9—12	...	...	...	...	...	...	...	×
— — var. *globosa*, Salter. Dav. Sil. Mon. (vol. iii), p. 89, pl. ix, figs. 7, 8	...	...	...	...	...	...	...	×
RETICULARIA (Spirifera) *lineata*, Martin. Dav. Carb. Mon. (vol. ii), p. 62, pl. xiii, figs. 4—10; p. 225, pl. li, fig. 15. Carb. Sup. (vol. iv), p. 275, pl. xxxii, figs. 6—11; pl. xxxiv, figs. 8, 9. Dev. Mon. (vol. iii), p. 43, pl. iv, figs. 13—16. Dev. Sup. (vol. v), pl. ii, fig. 5	...	...	...	...	...	×	×	
— — var. *reticulata*, Sow. Dav. Carb. Mon. (vol. ii), pl. xiii, figs. 11—13	...	...	...	...	...	×		
— — var. *elliptica*, Phillips. Dav. Carb. Mon. (vol. ii), p. 63, pl. xiii, figs. 1—3	...	...	...	...	...	×		
SYRINGOTHYRIS (Spirifera) *cuspidata*, Martin (under Spirifera). Dav. Carb. Mon. (vol. ii), pp. 44, 224, pl. viii, figs. 19—24; and pl. lii, fig. 3; pl. ix, figs. 1, 2. Carb. Sup. (vol. iv), p. 278, pl. xxxii, fig. 16; and pl. xxxiii, figs. 1—3	...	...	...	...	...	×		
— *distans*, Sow. Dav. Carb. Mon. (vol. ii), p. 46, pl. viii, figs. 1—17; p. 224. Carb. Sup. (vol. iv), p. 281, pl. xxxiii, figs. 4, 5	...	...	...	...	...	×		
— *bicarinata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 47, pl. viii, fig. 18 (it seems to be a synonym of *Sy. distans*)	...	...	...	...	...	×		
— *sub-conica*, Martin. Dav. Carb. Mon. (vol. ii), p. 48, pl. ix, fig. 3; pl. lii, fig. 4. Carb. Sup. (vol. iv), p. 281, pl. xxxii, fig. 17	...	...	...	...	...	×		

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
SPIRIFERINA *rostrata*, Schl. Dav. (pars) Ool. Mon. (vol. i), p. 20, pl. ii, figs. 1—6 and 13—21 (not 7—12, or pl. iii, fig. 1). Ool. Sup. (vol. iv), p. 95, pl. ix, fig. 6	...	...	...	×				
— *Hartmanni*, Zeiten. Dav. Ool. Mon. (vol. ii), p. 22, pl. ii, figs. 10—12; and Ool. Sup. (vol. iv), p. 95, pl. xi, fig. 7	...	...	...	×				
— *pinguis*, Zeiten (not Sow.). Dav. Ool. Mon. (pars), (vol. i), p. 20, pl. ii, figs. 7—9. Ool. Sup. (vol. iv), p. 96, pl. xi, fig. 8	...	...	...	×				
— *verrucosa*, v. Buch. Dav. Ool. Mon. (vol. i), (pars), p. 20, pl. iii, fig. 1. Ool. Sup. (vol. iv), p. 97, pl. xi, figs. 9, 10	...	...	...	×				
— *Walcotti*, Sow. Dav. Ool. Mon. (vol. i), p. 25, pl. iii, figs. 2, 3. Ool. Sup. (vol. iv), p. 98	...	...	...	×				
— *oxyptera*, Bouvigner. Dav. Ool. Sup. (vol. iv), p. 99, pl. x, figs. 31, 32	...	...	...	×				
— *signiensis*, Buv.? Dav. Ool. Sup. (vol. iv), p. 99, pl. xi, fig. 11	...	...	...	×				
— *oxygona*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 100, pl. xi, figs. 1—5	...	...	...	×				
— *Muensterii*, Dav. Ool. Mon. (vol. i), p. 26, pl. iii, figs. 4—6. Ool. Sup. (vol. iv), p. 101	...	...	...	×				
— *Deslongchampsii*, Dav. Ool. Sup. (vol. iv), p. 101, pl. xi, fig. 12	...	...	...	×				
— *Ilminsteriensis*, Dav. Ool. Mon. (vol. i), p. 24, pl. iii, fig. 7. Ool. Sup. (vol. iv), p. 101	...	...	...	×				
— *adscendens*, E. Desl. Dav. Ool. Sup. (vol. iv), p 227, pl. xxix, fig. 20 (not British—French)	...	...	...	×				
— *Tessoni*, var.? Dav. Ool. Sup. (vol. iv), p. 228, pl. xxix, fig. 21 (not British—French)	...	...	...	×				
— ? *oolitica*, Moore. Dav. Appendix to vol. i, p. 30; and Ool. Sup. (vol. iv), p. 102, pl. xi, figs. 13—15	...	...	...	×				
— ? *minima*, Moore. Dav. Ool. Sup. (vol. iv), p. 103, pl. xi, fig. 17	...	...	...	×				
— ? *Moorei*, Dav. Ool. Sup. (vol. iv), p. 103, pl. xiii, fig. 20	...	...	...	×				
— *cristata*, Schl. Dav. Perm. Mon. (vol. ii), p. 17, 226, pl. i, figs. 37—40, 45, 46; pl. ii, figs. 43—45; pl. iii, figs. 9, 10, 13. Dev. Mon. (vol. iii), p. 46, pl. vi, figs. 11—15	...	...	...	...	×	×	×	
— — var. *octoplicata*, Dav. Carb. Mon. (vol. ii), p. 38, pl. vii, figs. 37—47, 60 and 61; p. 226, pl. iii, figs. 9, 10, 13. Dav. Dev. Mon. (vol. iii), p. 123. Bud. Sal. Mon. (vol. iv), p. 340, pl. xxxviii, figs. 7, 8	...	...	...	...	...	×	×	
— *multiplicata*, Sow. Dav. Perm. Mon. (vol. ii), p. 19, pl. i, figs. 41—44	...	...	...	...	×			
— *Etheridgei*, Dav. Carb. Sup. (vol. iv), p. 278	...	...	...	...	...	×		
— *laminosa*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 36, pl. vii, figs. 17—22. Carb. Sup. (vol. v), p. 277	...	...	...	...	...	×		
— *partita*, Portlock. Dav. Carb. Mon. (vol. ii), p. 41, pl. vii, figs. 60, 61 (is a syn. of *Sp. octoplicata*)	...	...	...	...	...	×		
— *insculpta*, Phillips. Dav. Carb. Mon. (vol. ii), p. 42, pl. vii, figs. 48—55. Carb. Sup. (vol. iv), pl. iii, figs. 14, 15. Dev. Sup. (vol. v), pl. i, fig. 32	...	...	...	...	...	×	×	
CYRTIA *exporrecta*, Wahl. Dav. Sil. Mon. (vol. iii), p. 99, pl. ix, fig. 13—24. Sil. Sup. (vol. v), p. 137, pl. vi, fig. 13; p. 137, pl. viii, figs. 4, 5	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
CYRTIA ? *Whidbornei*, Dav. Dev. Sup. (vol. v), p. 36, pl. ii, figs. 6, 7	...	...	...	...	...	...	×	
CYRTINA *septosa*, Phillips. Dav. Carb. Mon. (vol. ii), p. 68, pl. xiv, figs. 1—10; pl. xv, figs. 1, 2, p. 227; pl. li, fig. 17; pl. li, fig. 19	...	...	...	...	...	×		
— *dorsata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 70, pl. xv, figs. 3, 4	...	...	...	...	...	×		
— *carbonaria*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 71, pl. xv, figs. 5—14	...	...	...	...	...	×		
— *heteroclita*, Def. Dav. Dev. Mon. (vol. iii), p. 48, pl. ix, figs. 1—16. Dev. Sup. (vol. v), p. 37, pl. i, figs. 35—37	...	...	...	...	...	...	×	
— — var. *multiplicata*, Dav. Dev. Mon. (vol. iii), pl. ix, p. 49, figs. 11—14	...	...	...	...	...	...	×	
— *Demarlii*, Bouchard. Dav. Dev. Mon. (vol. iii), p. 50, pl. ix, figs. 15—17	...	...	...	...	...	...	×	
— ? *amblygona*, Phillips. Dav. Dev. Mon. (vol. iii), p. 51, pl. ix, figs. 18—20	...	...	...	...	...	...	×	
ATHYRIS *pectinifera*, Sow. Dav. Permian Mon. (vol. ii), p. 21, pl. i, figs. 50—56; pl. ii, figs. 1—5	...	...	...	...	×			
— *planosulcata*, Phillips. Dav. Carb. Mon. (vol. ii), p. 80, pl. xvi, figs. 2—13, 15, p. 217; pl. li, figs. 11—13. Carb. Sup. (vol. iv), pl. xxxii, fig. 20. Sil. Sup. (vol. v), p. 98, pl. iv, figs. 14—19	...	...	...	...	...	×		
— *ambigua*, Sow. Dav. Carb. Mon. (vol. ii), p. 77, pl. xv, figs. 16—22; and pl. xvii, figs. 11—14. Carb. Sup. (vol. iv), p. 283, pl. xxxiv, figs. 10, 11	...	...	...	...	...	×		
— *lamellosa*, L'Eveillé. Dav. Carb. Mon. (vol. ii), p. 79, pl. xvi, fig. 1; and pl. xvii, fig. 6; p. 217, pl. li, fig. 14. Carb. Sup. (vol. iv), p. 217, pl. xxxii, fig. 19	...	...	...	...	...	×		
— *expansa*, Phillips. Dav. Carb. Mon. (vol. ii), p. 82, pl. xvi, figs. 14, 16, 18; pl. xvii, figs. 1—5	...	...	...	...	...	×		
— *squamigera*, de Kon.? Dav. Carb. Mon. (vol. ii), p. 83, pl. xviii, figs. 12, 13	...	...	...	...	...	×		
— *Royssii*, l'Eveillé. Dav. Carb. Mon. (vol. ii), p. 84, pl. xviii, figs. 1—11. Carb. Sup. (vol. iv), pl. xxxii, fig. 18; pl. xxxiv, figs. 7 and 12	...	...	...	...	...	×		
— *globularis*, Phil. Dav. Carb. Mon. (vol. ii), p. 86, pl. xvii, figs. 15—18	...	...	...	...	...	×		
— *subtilita*, Hall. Dav. Carb. Mon. (vol. ii), p. 18, pl. i, figs. 21, 22; pl. xvii, figs. 8—10, and p. 217	...	...	...	...	...	×		
— *Carringtoniana*, Dav. Carb. Mon. (vol. ii), p. 217, pl. lii, figs. 18—20	...	...	...	...	...	×		
— *pisum*, Dav. Carb. Sup. (vol. iv), p. 282, pl. xxx, fig. 15	...	...	...	...	...	×		
— *concentrica*, v. Buch. Dav. Dev. Mon. (vol. iii), p. 14, pl. iii, figs. 11—15 and 24; Dev. Sup. (vol. v), p. 25, pl. i, figs. 23, 24; pl. ii, fig. 10	...	...	...	...	...	...	×	
— ? *Bartoniensis*, Dav. Dev. Mon. (vol. iii), p. 19, pl. iii, fig. 23	...	...	...	...	...	...	×	
— *Glassii*, Dav. Dev. Sup. (vol. v), p. 24, pl. i, figs. 21, 22	...	...	...	...	...	...	×	
— ? *Newtoniensis*, Dav. Dev. Mon. (vol. iii), p. 19, pl. iii, fig. 22	...	...	...	...	...	...	×	
— Sp. Dav. Dev. Mon. (vol. iii), p. 19, pl. iv, fig. 4	...	...	...	...	...	...	×	
— ? *phalæna*, Phil. Dav. Dev. Mon. (vol. iii), p. 18, pl. iii, figs. 19—21	...	...	...	...	...	...	×	
— *rugata*, Dav. Dev. Sup. (vol. v), p. 26, pl. i, fig. 25	...	...	...	...	...	...	×	

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
ATHYRIS *incerta*, Dav. Bud.-Salt. Mon. (vol. iv), p. 338, pl. xxxviii, fig. 5	...	...	...	...	...	...	×	
— *Budleighensis*, Dav. Bud.-Salt. Mon. (vol. iv), p. 338, pl. xxxviii, fig. 6	...	...	...	...	...	...	×	
— ? *erratica*, Dav. Bud.-Salt. Mon. (vol. iv), p. 338, pl. xxxviii, fig. 4	...	...	...	...	...	...	×	
— ? *læviuscula*, Sow. Dav. Sil. Mon. (vol. iii), pl. x, figs. 28—32. Sil. Sup. (vol. v), p. 101, pl. iv, figs. 24—26	...	...	...	...	...	...	...	×
WHITFIELDIA *tumida*, Dalman (as *Meristella tumida*, Dav.). Sil. Mon. (vol. iii), p. 109, pl. xi, figs. 1—13. Sil. Sup. (vol. v), p. 107, pl. v, figs. 5, 6; and pl. vi, figs. 1—9	...	...	...	...	...	...	...	×
MERISTA *plebeia*, Sow. (=*scalprum*, Roemer). Dav. Dev. Mon. (vol. iii), p. 20, pl. iii, figs. 2—10; and Dev. Sup. (vol. v), p. 20, pl. i, figs. 26—29	...	...	...	...	...	...	×	
— ? *Circe*, Barrande? Dav. Sil. Mon. (vol. iii), p. 116, pl. x, figs. 33—35. Sil. Sup. (vol. v), p. 105	...	...	...	...	...	...	...	×
— ? *cymbula*, Dav. Sil. Mon. (vol. iii), p. 204, pl. xxii, figs. 28, 29. Sil. Sup. (vol. v), p. 138, pl. viii, fig. 6—9. (It is still uncertain whether we possess any British Silurian species of the genus. *M. ? cymbula* evidently belongs to another genus not yet determined)	...	...	...	...	...	...	...	×
MERISTELLA. (It is uncertain whether any of the following species are really referable to Hall's genus.)								
— ? *angustifrons*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 111, pl. x, figs. 21—27. Sil. Sup. (vol. v), pl. viii, fig. 1	...	...	...	...	...	...	...	×
— ? *crassa*, Sow. Dav. Sil. Mon. (vol. iii), p. 117, pl. viii, figs. 1—3	...	...	...	...	...	...	...	×
— ? *furcata*, Sow. Dav. Sil. Mon. (vol. iii), p. 119, pl. xiii, figs. 7—9	...	...	...	...	...	...	...	×
— ? *Maclareni*, Haswell. Dav. Sil. Mon. (vol. iii), p. 116, pl. xii, fig. 20	...	...	...	...	...	...	...	×
— ? *sub-undata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 120, pl. xiii, fig. 4. Sil. Sup. (vol. v), p. 133, pl. vii, figs. 10, 11	...	...	...	...	...	...	...	×
BIFIDA *lepida*, Goldf. (*Atrypa*, Dav.). Dev. Mon. (vol. iii), p. 52, pl. x, fig. 2. Dev. Sup. (vol. v), p. 27, pl. ii, fig. 13	...	...	...	...	...	...	×	
— *Huntii*, Dav. Dev. Sup. (vol. v), p. 28, pl. i, figs. 17, 18	...	...	...	...	...	...	×	
UNCITES *gryphus*, Schlot. Dav. Dev. Mon. (vol. iii), p. 22, pl. iv, figs. 11, 12. Dev. Sup. (vol. v), p. 30, pl. iii, figs. 4—10	...	...	...	...	...	...	×	
KAYSERIA *lens*, Phil. *Atrypa*, Dav. Dev. Mon. (vol. iii), p. 51, pl. x, fig. 1. Dev. Sup. (vol. v), p. 21, pl. ii, figs. 11, 12	...	...	...	...	...	...	×	
DAYIA *navicula*, Sow. (as Rhynchonella). Dav. Sil. Mon. (vol. iii), p. 190, pl. xxii, figs. 20—23. Sil. Sup. (vol. v), p. 96, pl. v, figs. 1—4	...	...	...	...	...	...	...	×
NUCLEOSPIRA *pisum*, Sow. Dav. Sil. Mon. (vol. iii), p. 106, pl. x, figs. 16—20. Sil. Sup. (vol. v), p. 91, pl. iv, figs. 15—18	...	...	...	...	...	...	...	×
— *Vicaryi*, Dav. Bud.-Salt. Mon. (vol. iv), p. 355, pl. xl, figs. 29—31	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
GLASSIA *obovata*, Sow. (as *Athyris*). Dav. Sil. Mon. (vol. iii), p. 121, pl. xii, fig. 19; pl. xiii, fig. 5. Sil. Sup. (vol. v), p. 116, pl. vii, figs. 11—20	...	...	...	...	...	...	...	×
— *compressa*, Sow. (as *Athyris*). Dav. Sil. Mon. (vol. iii), p. 122, pl. xii, figs. 16—18	...	...	...	...	...	...	...	×
— *elongata*, Dav. Sil. Sup. (vol. v), p. 119, pl. vii, figs. 9, 10	...	...	...	...	...	...	...	×
— *Whidbornei*, Dav. Dev. Sup. (vol. v), p. 38, pl. i, figs. 10—14	...	...	...	...	...	..	×	
ZIGOSPIRA *anticostiensis*, Billings (as *Atrypa Headii*, var. *anglica*). Dav. Sil. Mon. (vol. iii), pl. xxii, figs. 1—8; and Sil. Sup. (vol. v), p. 127	...	...	...	...	...	...	...	×
RETZIA (Eumetria?) *radialis*, Phillips. Dav. Carb. Mon. (vol. ii), p. 87, pl. xvii, figs. 19, 20, pl. li, figs. 4—9; and Carb. Sup. (vol. iv), p. 218, pl. li, figs. 4—9	...	...	...	...	...	×		
— *carbonaria*, Dav. Carb. Mon. (vol. ii), p. 219, pl. li, fig. 3. Carb. Sup. (vol. iv), p. 283, pl. xxx, fig. 16	...	...	...	...	...	×		
— (Eumetria?) *ulotrix*, de Kon. Dav. Carb. Mon. (vol. ii), pp. 88, 218, pl. xviii, figs. 14, 15	...	...	...	...	...	×		
— Sp.? Dav. Carb. Mon. (vol. ii), pl. li, fig. 10. Uncertain species	...	...	...	...	...	×		
— *longirostris*, Kayser (not *R. ferita*, von Buch.). Dav. Dev. Mon. (vol. iii), p. 21, pl. iv, figs. 8—10. Dev. Sup. (vol. v), p. 29, pl. i, figs. 30, 31	...	...	...	...	...	...	×	
— *Salteri*, Dav. Sil. Mon. (vol. iii), p. 125, pl. xii, figs. 21, 22; and Sil. Sup. (vol. v), p. 92, pl. iv, figs. 12—14	...	...	...	...	...	...	...	×
— — var. *Bouchardi*, Dav. Sil. Mon. (vol. iii), p. 127, pl. xii, figs. 26—30	...	...	...	...	...	...	...	×
— — var. *Baylei*, Dav. Sil. Mon. (vol. iii), p. 127, pl. xii, figs. 23, 25, 27	...	...	...	...	...	...	...	×
MERISTINA *didyma*, Dalman (as Meristella?) Dav. Sil. Mon. (vol. iii), p. 112, pl. xii, figs. 1—10; and Sil. Sup. (vol. v), p. 94, pl. iv, figs. 20—23	...	...	...	...	...	..	...	×
— = *nitida*, Hall (synonym of *M. didyma*). Dav. Sil. Mon. (vol. iii), p. 114, pl. x, figs. 28—32	...	...	...	...	...	...	...	×
ATRYPA *reticularis*, Linné. Dav. Dev. Mon. (vol. iii), p. 53, pl. x, figs. 3, 4. Dev. Sup. (vol. v), p. 39, pl. i, fig. 16. Sil. Mon. (vol. iii), p. 129, pl. xiv, figs. 1—21. Sil. Sup. (vol. v), p. 109, pl. vi, figs. 14, 15; and pl. vii, figs. 1—6	...	...	...	...	...	..	×	×
— — var. *aspera*, Schl. Dav. Dev. Mon. (vol. iii), p. 57, pl. x, figs. 5—8. Dev. Sup. (vol. v), p. 40	...	...	...	...	...	...	×	
— *desquamata*, Sow. Dav. Dev. Mon. (vol. iii), p. 58, pl. x, figs. 9—13; pl. xi, figs. 1—9. Dev. Sup. (vol. v), p. 39, pl. i, fig. 15.	...	...	...	...	...	...	×	
— *flabellata*, Gold. Dav. Dev. Mon. (vol. iii), p. 59, pl. xi, figs. 11, 12	...	...	...	...	...	...	×	
— ? *trigonella*, Dav. Dev. Sup. (vol. v), p. 40, pl. i, fig. 19	...	...	...	...	...	...	×	
— *asperula*, Dav. Sil. Mon. (vol. iii), pl. xiv, fig. 22. Sil. Sup. (vol. v), p. 112, pl. iv, fig. 8	...	...	...	...	...	...	...	×
— *marginalis*, Dalman. Dav. Sil. Mon. (vol. iii), p. 133, pl. xv, figs. 1, 2. Sil. Sup. (vol. v), p. 113, pl. vii, fig. 8	...	...	...	...	...	...	...	×
— *Barrandii*, Dav. (under *Retzia*). Dav. Sil. Mon. (vol. iii), p. 128, pl. xiii, figs. 10—13. Sil. Sup. (vol. v), p. 114, pl. vii, fig. 7	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
ATRYPA *imbricata*, Sow. Dav. Sil. Mon. (vol. iii), p. 135, pl. xv, figs. 3—8. Sil. Sup. (vol. v), p. 115, pl. iv, fig. 7	...	...	...	...	...	...	...	×
— ? *Mawii*, Dav. Sil. Sup. (vol. v), p. 116, pl. iv, fig. 6	...	...	...	...	...	...	...	×
TRIPLESIA *insularis*, Eichw. (*Orthis*). Dav. Sil. Mon. (vol. iii), p. 373, pl. xxxvii, figs. 8—15. Sil. Sup. (vol. v), p. 143, pl. viii, figs. 17—22	...	...	...	...	...	...	...	×
— *Wenlockiensis*, Dav. Sil. Mon. (vol. iii), p. 144, pl. viii, fig. 23	...	...	...	...	...	...	...	×
— ? *Grayiæ*, Dav. Sil. Mon. (vol. iii), p. 198, pl. xxiv, figs. 31, 32; pl. xxv, figs. 9—11. Sil. Sup. (vol. v), p. 144, pl. viii, fig. 32	...	...	...	...	...	...	...	×
— ? *Maccoyana*, Dav. Sil. Sup. (vol. iii), p. 199, pl. xxiv, fig. 20	...	...	...	...	...	...	...	×
— ? *monilifera*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 200, pl. xxv, figs. 3, 5. Sil. Sup. (vol. v), p. 147, pl. viii, fig. 31	...	...	...	...	...	...	...	×
— ? *incerta* (as *Atrypa?*), Dav. Sil. Mon. (vol. iii), p. 203, pl. xxiv, fig. 30; pl. xxv, figs. 7, 8. Sil. Sup. (vol. v), p. 145, pl. viii, figs. 24—29	...	...	...	...	...	...	...	×
— ? *apiculata*, Salter. Dav. (as *Atrypa*) Sil. Mon. (vol. iii), p. 202, pl. xxv, fig. 6. Sil. Sup., p. 145	...	...	...	...	...	...	...	×
— ? *spiriferoides*, M'Coy (as *Orthis*). Dav. Sil. Mon. (vol. iii), p. 275, pl. xxxvii, figs. 3—7. Sil. Sup. (vol. v), p. 146, pl. viii, fig. 30	...	...	...	...	...	...	...	×
EICHWALDIA *Capewelli*, Dav. Sil. Mon. (vol. iii), p. 193, pl. xxv, figs. 12—15. Sil. Sup. (vol. v), p. 140, pl. viii, figs. 15, 16. General Summary, p. 355	...	...	...	...	...	...	...	×
LEPTOCŒLIA *hemisphærica*, Sow. (*Atrypa*). Dav. Sil. Mon. (vol. iii), p. 136, pl. xiii, figs. 23—30 (belongs in all probability to the sub-family *Centronellinæ*)	...	...	...	...	...	...	...	×
STREPTIS *Grayii*, Dav. (as *Atrypa?*). Dav. Sil. Mon. (vol. iii), p. 141, pl. xiii, figs. 14—22. Sil. Sup. (vol. v), p. 139	...	...	...	...	...	...	...	×
PORAMBONITES *intercedens*, Pander. Dav. Sil. Mon. (vol. iii), p. 195 (in part), pl. xxv, fig. 16 (not 17—19), pl. xxvi, figs. 1—3	...	...	...	...	...	...	...	×
PENTAMERUS *biplicatus*, Schnur. Dav. Dev. Mon. (vol. iii), p. 73, pl. xiv, figs. 31, 32. Dev. Sup. (vol. v), p. 42, pl. ii, fig. 22	...	...	...	...	...	...	×	
— *brevirostris*, Phil. Dav. Dev. Mon. (vol. iii), p. 72, pl. xv, figs. 1—14	...	...	...	...	...	...	×	
— *Knightii*, Sow. Dav. Sil. Mon. (vol. iii), p. 142, pl. xvi, figs. 1—3; pl. xvii, figs. 1—10; pl. xix, fig. 3	...	...	...	...	...	...	...	×
— *undatus*, Sow. Dav. Sil. Mon. (vol. iii), p. 155, pl. xix, figs. 4—9; and Sil. Sup. (vol. v), p. 162, pl. ix, figs. 10—20	...	...	...	...	...	...	...	×
— *galeatus*, Dal. Dav. Sil. Mon. (vol. iii), p. 145, pl. xv, figs. 13—23. Sil. Sup. (vol. v), p. 164, pl. ix, fig. 25	...	...	...	...	...	...	...	×
— *linguifer*, Sow. Dav. Sil. Mon. (vol. iii), p. 149, pl. xvii, figs. 11—14	...	...	...	...	...	...	...	×
— *rotundus*, Sow. Dav. Sil. Mon. (vol. iii), p. 150, pl. xv, figs. 9—11. Sil. Sup. (vol. v), p. 163, pl. ix, figs. 6—9	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
PENTAMERUS *oblongus*, Sow. Dav. Sil. Mon. (vol. iii), p. 151, pl. xviii, figs. 1—12; pl. xix, fig. 1, 2. Sil. Sup. (vol. v), p. 161	...	...	...	...	...	...	...	×
— *globosus*, Sow. Dav. Sil. Mon. (vol. iii), p. 156, pl. xix, figs. 10—12. Sil. Sup. (vol. v), p. 163, pl. ix, figs. 21—24	...	...	...	...	...	...	...	×
— ? *Shallockiensis*, Dav. Sil. Sup. (vol. v), p. 164, pl. ix, fig. 26	...	...	...	...	...	...	...	×
STRICKLANDINIA *lirata*, Sow. Dav. Sil. Mon. (vol. iii), p. 159, pl. xx, figs. 1—13. Sil. Sup. (vol. v), p. 165, pl. ix, fig. 1	...	...	...	...	...	...	...	×
— *lens*, Sow. Dav. Sil. Mon. (vol. iii), p. 161, pl. xix, figs. 13—23. Sil. Sup. (vol. v), p. 165, pl. ix, figs. 2—5	...	...	...	...	...	...	...	×
— ? *Balcletchiensis*, Dav. Sil. Sup. (vol. v), p. 166, pl. ix, figs. 27—29	...	...	...	...	...	...	...	×
RHYNCHOPORA *Youngii*, Dav. Carb. Mon. (vol. ii), p. 286, pl. xxxiii, fig. 11	...	...	...	...	...	×		
CAMAROPHORIA *Schlotheimi*, v. Buch. Dav. Perm. Mon. (vol. ii), p. 25, pl. ii, figs. 16—27 (possibly a synonym of *Cam. crumena*, Martin)	...	...	...	...	×	×		
— *globulina*, Phillips. Dav. Perm. Mon. (vol. ii), p. 27, pl. ii, figs. 28—31. Carb. Mon. (vol. ii), p. 115, pl. xxiv, figs. 9—22	...	...	...	...	×	×	×	
— *Humbletoniensis*, Howse = *C. multiplicata*, King. Dav. Perm. Mon. (vol. ii), p. 27, pl. ii, figs. 9—15	...	...	...	...	×			
— *Kingii*, Dav. Carb. Sup. (vol. iv), p. 287, pl. xxxiii, figs. 12, 13	...	...	...	...	...	×		
— *crumena*, Martin. Dav. Carb. Mon. (vol. ii), p. 113, pl. xxv, figs. 3—9; p. 267, pl. liv, figs. 16—18	...	...	...	...	...	×		
— ? *laticliva*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 116, pl. xxv, figs. 11, 12	...	...	...	...	...	×		
— *isorhyncha*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 117, pl. xxv, figs. 1, 2	...	..	...	...	...	×		
— *rhomboidea*, Phil. Dav. Carb. Mon. (vol. ii), p. 268, pl. liv, figs. 20—22. Dav. Dev. Mon. (vol. iii), p. 70, pl. xiv, figs. 19—22. Dev. Sup. (vol. v), p. 48. (*C. rhomboidea* and *C. globulina* are probably one and same species)	...	...	...	...	...	×	×	
RHYNCHONELLA *psittacea*, Chemnitz. Dav. Recent Sup. (vol. iv), pl. iv, p. 8. Tert. Mon. (vol. i), p. 21, pl. i, fig. 7. Tert. Sup. (vol. iv), p. 16, pl. ii, fig. 5	×	×						
— *plicatilis*, Sow. Dav. Cret. Mon. (vol. i), p. 75, pl. x, figs. 37—42. Cret. Sup. (vol. iv), p. 57	...	...	×					
— — var. *octoplicata*, Sow. Dav. Cret. Mon. (vol. i), p. 77, pl. x, figs. 1—17	...	...	×					
— — var. *Woodwardii*, Dav. Cret. Mon. (vol. i), p. 77, pl. x, figs. 43—46	...	...	×					
— *limbata*, Schl. Dav. Cret. Mon. (vol. i), p. 79, pl. xii, figs. 1—5	...	...	×					
— — var. *robusta*, Tate. Dav. Cret. Sup. (vol. iv), p. 57, pl. vii, fig. 18	...	...	×					

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *Martini*, Mantell. Dav. Cret. Mon. (vol. i), p. 94, pl. xii, figs. 15, 16. Cret. Sup. (vol. iv), p. 57...	...	...	×					
— *Grasiana*, d'Orb. Dav. Cret. Mon. (vol. i), p. 96, pl. xii, figs. 17—19. Cret. Sup. (vol. iv), p. 57...	...	...	×					
— *Mantelliana*, Sow. Dav. Cret. Mon. (vol. i), p. 87, pl. xii, figs. 20—23. Cret. Sup. (vol. iv), p. 58...	...	...	×					
— *Cuvieri*, d'Orb. Dav. Cret. Mon. (vol. i), p. 88, pl. x, figs. 50—54. Cret. Sup. (vol. iv), p. 58...	...	...	×					
— *sulcata*, Park. Dav. Cret. Mon. (vol. i), p. 85, pl. x, figs. 18—20 and 23—36; 21, 22? Cret. Sup. (vol. iv), p. 58	...	...	×					
— *Schlœnbachi*, Dav. (not *depressa*). Cret. Mon. (vol. i), pl. xii, figs. 28—30. Cret. Sup. (vol. iv), p. 59...	...	...	×					
— *lineolata*, Phillips. Dav. Cret. Mon. (vol. i), p. 98, pl. xii, fig. 6 only. Cret. Sup. (vol. iv), p. 59 ...	...	...	×					
— *Carteri*, Dav. (not *lineolata*). Cret. Mon. (vol. i), p. 98, pl. xii, figs. 7—10. Cret. Sup. (vol. iv), p. 60	...	...	×					
— *dimidiata*, Sow. Dav. Cret. Mon. (vol. i), p. 80, pl. xi, figs. 1—5; pl. xii, fig. 25 (not *R. compressa*, Lam.). Cret. Sup. (vol. iv), p. 60.....	...	...	×					
— — var. *convexa*, Sow. Dav. Cret. Mon. (vol. i), pl. xi, figs. 6—14; pl. xii, fig. 24. Cret. Sup. (vol. iv), p. 62	...	...	×					
— *latissima*, Sow. (lata). Dav. Cret. Mon. (vol. i), p. 82, pl. xi, figs. 15—22 (not 6—14, nor pl. xii, figs. 24, 28—30. Cret. Sup. (vol. iv), p. 62.....	...	...	×					
— *multiformis*, Roemer (pars). Dav. Cret. Sup. (vol. iv), p. 63, pl. viii, figs. 22, 23	...	...	×					
— *antidichotoma*, Dav. Cret. Sup. (vol. iv), p. 65, pl. viii, figs. 19—21	...	...	×					
— *nuciformis*, Sow. Dav. Cret. Mon. (vol. i), p. 93, pl. x, figs. 23—27 (not pl. xii, fig. 27). Cret. Sup. (vol. iv), p. 66	...	...	×					
— *Wiestii*, Quenstedt. Dav. Cret. Sup. (vol. iv), p. 66, pl. viii, fig. 31.....	...	...	×					
— *Upwarensis*, Dav. Cret. Sup. (vol. iv), p. 66, pl. viii, figs. 27, 28.....	...	...	×					
— *Gibbsiana*, Sow. Dav. Cret. Mon. (vol. i), p. 98, pl. xii, figs. 11, 12. Cret. Sup. (vol. iv), p. 67...	...	...	×					
— *parvirostris*, Sow. Dav. Cret. Mon. (vol. i), p. 97, pl. xii, figs. 13, 14. Cret. Sup. (vol. iv), p. 67, pl. viii, fig. 29	...	...	×					
— *Cantabrigensis*, Dav. Cret. Sup. (vol. iv), p. 68, pl. viii, fig. 30.....	...	...	×					
— *Walkeri*, Dav. Cret. Sup. (vol. iv), p. 68, pl. viii, figs. 33, 34.....	...	...	×					
— *Speetonensis*, Dav. Cret. Sup. (vol. iv), p. 69, pl. viii, fig. 32.....	...	...	×					
— *depressa*, Sow. Dav. Cret. Mon. (vol. i), p. 89, pl. xi, figs. 28—32; pl. xii, fig. 26 (not 28—30?). Cret. Sup. (vol. iv), p. 58, pl. viii, figs. 24, 25. Appendix to Sup. (vol. v), p. 252	...	...	×					
— *Wrightii*, Dav. Dav. Ool. Mon. (vol. i), p. 69, pl. xiv, fig. 1; and Appendix to (vol. i), p. 21, pl. A, fig. 27. Ool. Sup. (vol. iv), p. 188	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *furcillata*, Theodori. Dav. Ool. Mon. (vol. i), p. 69, pl. xiv, figs. 2—5; and Ool. Sup. (vol. iv), p. 189, pl. xxvii, figs. 1—3	...	...	...	×				
— *rimosa*, v. Buch. Dav. Ool. Mon. (vol. i), p. 70, pl. xiv, fig. 6. Ool. Sup. (vol. iv), p. 189, pl. xxvii, fig. 10	...	...	...	×				
— *serrata*, Sow. Dav. Ool. Mon. (vol. i), p. 85, pl. xv, figs. 1, 2. Ool. Sup. (vol. iv), p. 189	...	...	...	×				
— *plicatella*, Sow. Dav. Ool. Mon. (vol. i), p. 86, pl. xvi, figs. 7, 8; and Ool. Sup. (vol. iv), p. 190, pl. xxvii, figs. 4—7	...	...	...	×				
— *Sutherlandi*, Dav. Ool. Sup. (vol. iv), p. 190, pl. xxv, figs. 5—8	...	...	...	×				
— *inconstans*, Sow. Dav. Ool. Mon. (vol. i), p. 87, pl. xviii, figs. 1—4; and Ool Sup. (vol iv), p. 191, pl. xxvi, figs. 1, 6	...	...	...	×				
— *pinguis*, Roemer. Dav. Ool. Sup. (vol. iv), p. 193, pl. xxvi, fig. 7	...	...	...	×				
— — var. *pectunculoides*, Etalon. Dav. Ool. Sup. (vol. iv), p. 194, pl. xxvi, figs. 8—12	...	...	...	×				
— *lacunosa*, Schl. Dav. Ool. Sup. (vol. iv), p. 196, pl. xxvi, figs. 13, 14	...	...	...	×				
— *Boueti*, Dav. Ool. Sup. (vol. iv), p. 197, pl. xxvi, figs. 15, 16	...	...	...	×				
— *tetrahedra*, Sow. Dav. Ool. Mon. (vol. i), p. 93, pl. xviii, figs. 5—9 (not 10); pl. xvi, figs. 13, 14, and p. 96. Ool. Sup. (vol. iv), p. 198, pl. xxix, fig. 6	...	...	...	×				
— — var. *Dumbletonensis*, Dav. Ool. Sup. (vol. iv), p. 199, pl. xxix, fig. 5	...	...	...	×				
— — var. *Northamptonensis*, Dav. Ool. Sup. (vol. iv), p. 199, pl. xxix, figs. 7, 12	...	...	...	×				
— *sub-tetrahedra*, Dav. Ool. Mon. (vol. i), p. 95, pl. xvi, fig. 9—12. Ool. Sup. (vol. iv), p. 200	...	...	...	×				
— *Amalthei*, Quenstedt. Dav. Ool. Sup. (vol. iv), p. 200, pl. xxviii, figs. 18—21?	...	...	...	×				
— *sub-decorata*, Dav. Ool. Mon. (vol. i), pl. xviii, fig. 10; and Appendix to (vol. i), p. 21, pl. A, figs. 23—26; Ool. Sup. (vol. iv), p. 201	...	...	...	×				
— *quadriplicata*, Zeiten. Dav. Ool. Mon. Appendix to (vol. i), p. 23, pl. A, fig. 22; and Ool. Sup. (vol. iv), p. 201, pl. xxix, figs. 1—3	...	...	...	×				
— *pygmæa*, Morris. Dav. Ool. Mon. (vol. i), p. 57, pl. xiii, fig. 16. Ool. Sup. (vol. iv), p. 202	...	...	...	×				
— *Lycettii*, Dav. Ool. Mon. (vol. i), p. 81, pl. xv, fig. 6. Ool. Sup. (vol. iv), p. 203	...	...	...	×				
— *Moorei*, Dav. Ool. Mon. (vol. i), p. 82, pl. xv, figs. 11—14. Ool. Sup. (vol. iv), p. 203	...	...	...	×				
— *sub-variabilis*, Dav. Ool. Mon. (vol. i), p. 80, pl. xv, fig. 7, and pl. xviii, fig. 11. Ool. Sup. (vol. iv), p. 203	...	...	...	×				
— *acuta*, Sow. Dav. Ool. Mon. (vol. i), p. 76, pl. xiv, figs. 8, 9. Ool. Sup. (vol. iv), p. 203	...	...	...	×				
— *cynocephala*, Richard. Dav. Ool. Mon. (vol. i), p. 77, pl. xiv, figs. 10—12. Ool. Sup. (vol. iv), p. 204	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *ringens*, Herault. Dav. Ool. Mon. (vol. i), p. 74, pl. xiv, figs. 13—16. Ool. Sup. (vol. iv), p. 204, pl. xxvii, figs. 14—16	...	...	...	×				
— *sub-ringens*, Dav. Ool. Mon. (vol. i), p. 75, pl. xix, fig. 17. Ool. Sup. (vol. iv), p. 205	...	...	...	×				
— *Bouchardii*, Dav. Ool. Mon. (vol. i), p. 82, pl. xv, figs. 3—5. Ool. Sup. (vol. iv), p. 205, pl. xxix, fig. 19	...	...	...	×				
— *oolitica*, Dav. Ool. Mon. (vol. i), p. 81, pl. xiv, fig. 7. Ool. Sup. (vol. iv), p. 205	...	...	...	×				
— *Forbesii*, Dav. Ool. Mon. (vol. i), p. 84, pl. xvii, fig. 9. Ool. Sup. (vol. iv), p. 205	...	...	...	×				
— *concinna*, Sow. Dav. Ool. Mon. (vol. i), p. 88, pl. xvii, figs. 6—12. Ool. Sup. (vol. iv), p. 205, pl. xxvii, fig. 22	...	...	...	×				
— — var. *Yaxleyensis*, Dav. Ool. Sup. (vol. iv), p. 206, pl. xxvii, fig. 23	...	...	...	×				
— *sub-concinna*, Dav. Ool. Mon. (vol. i), p. 90, pl. xvii, fig. 17. Dav. Ool. Sup. (vol. iv), p. 206	...	...	...	×				
— *fodinalis*, Tate. Dav. Ool. Sup. (vol. iv), p. 206, pl. xxviii, figs. 39—41	...	...	...	×				
— *obsoleta*, Sow. Dav. Ool. Mon. (vol. i), p. 90, pl. xvii, figs. 1—5, and Var., Ool. Sup. (vol. iv), p. 207, pl. xxix, fig. 4	...	...	...	×				
— *sub-obsoleta*, Dav. Ool. Mon. (vol. i), p. 91, pl. xvii, fig. 14. Ool. Sup. (vol. iv), p. 207	...	...	...	×				
— *angulata*, Sow. Dav. Ool. Mon. (vol. i), p. 92, pl. xvii, fig. 13. Ool. Sup. (vol. iv), p. 207	...	...	...	×				
— — var. *sub-angulata*, Dav. Ool. Sup. (vol. iv), p. 208, pl. xxix, figs. 14—16	...	...	...	×				
— *variabilis*, Schl. Dav. Ool. Mon. (vol. i), p. 78, pars. pl. xv, figs. 8—10 only. Ool. Sup. (vol. iv), p. 208	...	...	...	×				
— *lineata*, Young and Bird. Dav. Ool. Mon. (vol. i), pl. xvi, figs. 1—3 (only). Ool. Sup. (vol. iv), p. 209, pl. xxix, figs. 17, 18	...	...	...	×				
— — var. *Radstockiensis*, Dav. Ool. Mon. (vol. iv), p. 210, pl. xvi, figs. 4—6	...	...	...	×				
— *oxynoti*, Quenstedt. Dav. Ool. Sup. (vol. iv), p. 210, pl. xxviii, figs. 37, 38	...	...	...	×				
— *triplicata*, Quenstedt. Dav. Ool. Mon. (vol. i), p. 78, pl. xvi, figs. 2, 5 (not *Rh. variabilis*); and Ool. Sup. (vol. iv), p. 211, pl. xxviii, figs. 35, 36	...	...	...	×				
— *varians*, Schloth. Dav. Ool. Mon. (vol. i), p. 83, pl. xvii, figs. 15, 16. Ool. Sup. (vol. iv), p. 212, pl. xxviii, figs. 3—12	...	...	...	×				
— — var. *Smithii*, Walker. Ool. Sup. (vol. iv), p. 213, pl. xxviii, figs. 1—3	...	...	...	×				
— — var. *socialis*, Phillips. Dav. Ool. Sup. (vol. iv), p. 214, pl. xxviii, figs. 8—11	...	...	...	×				
— — var. *spathica*, Lamarck. Dav. Ool. Sup. (vol. iv), p. 214, pl. xxviii, figs. 5—7	...	...	...	×				
— — var. *Thurmani*, Voltsz. Dav. Ool. Sup. (vol. iv), p. 215, pl. xxviii, figs. 14—16	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *Leedsii*, Walker. Dav. Ool. Sup. (vol. iv), p. 216, pl. xxviii, fig. 17	...	...	...	×				
— *egretta*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 216, pl. xxviii, fig. 23	...	...		×				
— ? *Lopensis*, Moore. Dav. Ool. Sup. (vol. iv), p. 217, pl. xxvii, figs. 8, 9	...	...	...	×				
— ? *coronata*, Moore. Dav. Ool. Sup. (vol. iv), p. 218, pl. xxvii, fig. 13	...	...	...	×				
— *Tatei*, Dav. Ool. Sup. (vol. iv), p. 218, pl. xxviii, fig. 45	...	...	...	×				
— *parvula*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 219, pl. xxvii, fig. 21	...	...	...	×				
— *Stephensi*, Dav. Ool. Sup. (vol. iv), p. 220, pl. xxvii, fig. 20	...	...	...	×				
— *calcicosta*, Quenstedt. Dav. Ool. Sup. (vol. iv), p. 220, pl. xxviii, figs. 24—33	...	...	...	×				
— *Glevensis*, Smithe. Dav. Ool. Sup. (vol. iv), p. 221, pl. xxviii, fig. 22	...	...	...	×				
— *capitulata*, Tate. Dav. Ool. Sup. (vol. iv), p. 222, pl. xxvii, figs. 11, 12	...	...	...	×				
— *spinosa*, Schl. Dav. Ool. Mon. (vol. i), p. 71, pl. xv, figs. 15—20. Dav. Ool. Sup. (vol. iv), p. 222	...	...	...	×				
— — var. *Bradfordiensis*, Walker. Dav. Ool. Sup. (vol. iv), p. 222, pl. xxvii, figs. 18, 19	...	...	...	×				
— *Crossi*, Walker. Dav. Ool. Sup. (vol. iv), p. 223, pl. xxvii, fig. 17	...	...	...	×				
— *senticosa*, von Buch. Dav. Ool. Mon. (vol. i), p. 73, pl. xv, fig. 21. Ool. Sup. (vol. iv), p. 223	...	...	...	×				
— *jurensis*, Quenstedt. Dav. Ool. Sup. (vol. iv), p. 224, pl. xxvii, figs. 24—27	...	...		×				
— *Morierei*, Dav. Ool. Mon. (vol. i), p. 92, pl. xviii, figs. 12, 13. Ool. Sup. (vol. iv), p. 225	...	...	...	×				
— *palma*, Szajnocha. Dav. App. to Sup. (vol. v), p. 271, pl. xix, fig. 21	...	...	...	×				
— Sp. Dav. App. to Sup. (vol. v), p. 271, pl. xx, fig. 11	...	...		×				
— *bilobata*, S. Buck. Dav. App. to Sup. (vol. v), p. 272, pl. xix, figs. 18, 19	...	...		×				
— *Dundriensis*, S. Buck. Dav. App. to Sup. (vol. v), p. 272, pl. xix, fig. 20	...	...	...	×				
— *Portlandica*, Blake. Dav. App. to Sup. (vol. v), p. 273, pl. xx, fig. 6	...	...		×				
— *Balinensis*, Suess MS. App. to Sup. (vol. v), p. 277, pl. xx, fig. 3	...	...	...	×				
— *Benecki*, Haas? Dav. App. to Sup. (vol. v), p. 274, pl. xx, figs. 8—10	...	...	...	×				
— *Gingensis*, Waagen. Dav. App. to Sup. (vol. v), p. 275, pl. xx, fig. 1	...	...		×				
— *fallax*, E. Desl. Dav. App. to Sup. (vol. v), p. 275, pl. xx, figs. 4, 5	...	...	...	×				
— *buteo*, Suess MS. Dav. App. to Sup. (vol. v), p. 276, pl. xx, fig. 7	...	...		×				
— *Dorsetiensis*, S. Buck. Dav. App. to Sup. (vol. v), p. 277, pl. xx, fig. 2	...	...	...	×				

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *cordiformis*, Sow. Dav. Carb. Mon. (vol. ii), p. 92, pl. xix, figs. 8—10 (pl. viii, ix, by mistake)	...	...	...	...	...	×		
— *acuminata*, Martin. Dav. Carb. Mon. (vol. ii), p. 93, pl. xx, figs. 1—13; pl. xxi, figs. 1—13. Dav. Mon. (vol. iii), p. 60, pl. xiii, figs. 1—4, 5?	...	...	...	...	...	×	×	
— — var. *platiloba*, Sow. Dav. Carb. Mon. (vol. ii), p. 93, pl. xxi, figs. 14—20. Dev. Sup. (vol. iv), p. 47	...	...	...	...	...	...	×	
— *pugnus*, Martin. Dav. Carb. Mon. (vol. ii), p. 97, pl. xxii, figs. 1—15. Dav. Dev. Mon. (vol. iii), p. 63, pl. xii, figs. 12—14; pl. xiii, figs. 8—10	...	...	...	...	...	×	×	
— *pleurodon*, Phillips. Dav. Carb. Mon. (vol. ii), p. 101, pl. xxiii, figs. 1—15; 16—22? Dav. Dev. Mon. (vol. iii), p. 62, pl. xiii, figs. 12, 13	...	...	...	...	...	×	×	
— *flexistria*, Phillips. Dav. Carb. Mon. (vol. ii), p. 105, pl. xxiv, figs. 1—8	...	...	...	...	...	×		
— *angulata*, Linné. Dav. Carb. Mon. (vol. ii), p. 107, pl. xix, figs. 11—16	...	...	...	...	...	×		
— ? *trilatera*, de Kon. Dav. Carb. Mon. (vol. ii), p. 109, pl. xxiv, figs. 23—26	...	...	...	...	...	×		
— *reniformis*, Dav. Carb. Mon. (vol. ii), p. 90, pl. xix, figs. 1—7. Dev. Mon. (vol. iii), p. 62, pl. 13, figs. 6, 7	...	...	...	...	...	×	×	
— ? *nana*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 110, pl. xxv, fig. 15	...	...	...	...	...	×		
— ? or *Camarophoria? proava*, Phil. Dav. Carb. Mon. (vol. ii), p. 111, pl. xxv, fig. 10	...	...	...	...	...	×		
— ? *semisulcata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 111, pl. xxv, fig. 13	...	...	...	...	...	×		
— ? *gregaria*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 112, pl. xv, figs. 27, 28	...	...	...	...	...	×		
— ? *Carringtoniana*, Dav. Carb. Mon. (vol. ii), p. 227, pl. xxiii, fig. 22; pl. liii, figs. 1, 2	...	...	...	...	...	×		
— *reflexa*, de Kon. Dav. Carb. Sup. (vol. iv), p. 284, pl. xxxiii, figs. 7—9	...	...	...	...	...	×		
— *Glassii*, Dav. Carb. Sup. (vol. iv), p. 285, pl. xxxiii, fig 10	...	...	...	...	..	×		
— *Brockleyensis*, Dav. Carb. Sup. (vol. iv), p. 285, pl. xxxiv, fig. 14	...	...	...	...	...	×		
— *contraria*, Roemer (under the mistaken name of *Rh. Wettoniensis*, Dav.). Carb. Mon. (vol. ii), p. 274, pl. lv, figs. 1—3	...	...	...	...	...	×		
— *angularis*, Phil. Dav. Dev. Mon. (vol. iii), p. 68, pl. xiv, figs. 11—13	...	...	...	...	...	...	×	
— *anisodonta*, Phil. Dav. (as part of *R. pugnus*) Dev. Mon. (vol. iii), p. 63, pl. xii, figs. 12—14; and Dev. Sup. (vol. v), p. 46	...	...	...	...	..	...	×	
— *bifera*, Phil. Dav. Dev. Mon. (vol. iii), p. 64, pl. xii, figs. 10, 11	...	...	...	...	...	...	×	
— *cuboides*, Sow. Dav. Dev. Mon. (vol. iii), p. 65, pl. xiii, figs. 16—21. Dev. Sup. (vol. v), p. 46, pl. ii, figs. 18, 19	...	...	...	...	..	...	×	
— *inflexa*, Sow. Dav. Dev. Mon. vol. iii), p. 67, pl. xiv, figs. 7—10	...	...	...	...	...	...	×	
— *laticosta*, Phil. Dav. Dev. Mon. (vol. iii), p. 61, pl. xiv, figs. 1—3	...	...	...	...	...	...	×	

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *Leei*, Dav. Dev. Sup. (vol. v), p. 47, pl ii, fig. 15	...	...	...	...	...	...	×	
— ? *Lummatoniensis*, Dav. Dev. Mon. (vol. iii), p. 70, pl. xiv, figs. 14—18	...	...	...	...	...	...	×	
— *Ogwelliensis*, Dav. Dev. Mon. (vol. iii), p. 69, pl. xiv, figs. 23—26. Dev. Sup. (vol. v), p. 44, pl. ii, fig. 16	...	...	...	...	...	...	×	
— *parallelepida*, Bronn. (*Rh. primipilaris*, Dav., not of Buch.). Dav. Dev. Mon. (vol. iii), p. 66, pl. xiv, figs. 4—6. Dev. Sup. (vol. v), p. 42	...	...	...	...	...	...	×	
— *Pengelliana*, Dav. Dev. Mon. (vol. iii), p. 61, pl. xii, figs. 8, 9	...	...	...	...	...	...	×	
— *Phillipsii*, Dav. Dev. Sup. (vol. v), p. 43, pl. ii, fig. 14	...	...	...	...	...	...	×	
— ? *protracta*, Sow. = *proboscidialis*, Phil. Dav. Dev. Mon. (vol. iii), p. 69, pl. xiv, figs. 27—29. Dev. Sup. (vol. v), p. 44, pl. ii, fig. 17	...	...	...	...	...	...	×	
— *sphærica*, Sow. Dav. Dev. Mon. (vol. iii), p. 66, pl. xiii, fig. 14	...	...	...	...	...	...	×	
— *subreniformis*, Schnur. Dav. Dev. Sup. (vol. v), p. 45	...	...	...	...	...	...	×	
— *triloba*, Sow. Dav. Dev. Mon. (vol. iii), p. 64, pl. xii, figs. 1—7. Dev. Sup. (vol. v), p. 47, pl. ii, fig. 21	...	...	...	...	...	...	×	
— *borealis*, Schl. Dav. Sil. Mon. (vol. iii), p. 174, pl. xxi, figs. 14—27 (excluding fig. 23, which belongs to *Rh. diodonta*, also *Rh. bidentata*, from synonyms). Sil. Sup. (vol. v), p. 148, pl. x, fig. 25	...	...	...	...	...	...	...	×
— *sub-borealis*. Dav. Sil. Sup. (vol. v), p. 149, pl. x, figs. 5, 6	...	...	...	...	...	...	...	×
— *Beltiana*, Dav. Sil. Mon. (vol. iii), p. 189, pl. xxiv, fig. 22	...	...	...	...	...	...	...	×
— *bidentata*, Hisinger (as part of *R. borealis*). Dav. Sil. Mon. (vol. iii), p. 174, pl. xxi, fig. 22. Sil. Sup. (vol. v), p. 150, pl. x, fig. 3	...	...	...	...	...	...	...	×
— *Balcletchiensis*, Dav. Sil. Sup. (vol. v), p. 160, pl. x, figs. 15, 16, and p. 200, pl. xi, fig. 23	...	...	...	...	...	...	...	×
— *cuneata*, Dalman. Dav. Sil. Mon. (vol. iii), p. 164, pl. xxi, figs. 7—11. Sil. Sup. (vol. v), p. 152, pl. x, figs. 9, 10	...	...	...	...	...	...	...	×
— *cuneatella*, Dav. Sil. Sup. (vol. v), p. 200, pl. x, fig. 11	...	...	...	...	...	...	...	×
— *Callawayana*, Dav. Sil. Sup. (vol. v), p. 159, pl. x, fig. 18	...	...	...	...	...	...	...	×
— *decemplicata*, Dav. Sil. Mon. (vol. iii), p. 177, pl. xxiii, fig. 20—24; p. 202, pl. xi, fig. 27. Sil. Sup. (vol. v), pp. 151, 202, pl. xi, fig. 27	...	...	...	...	...	...	...	×
— *deflexa*, Sow. Dav. Sil. Mon. (vol. iii), p. 156, pl xxii, figs. 24—27. Sil. Sup. (vol. v), p. 156	...	...	...	...	...	...	...	×
— *diodonta*, Dav. Sil. Sup. (vol. v), p. 151, pl. x, fig. 4	...	...	...	...	...	...	...	×
— *Davi*, Dav. Sil. Sup. (vol. v), p. 152, pl. x, fig. 2	...	...	...	...	...	...	...	×
— *Edgelliana*, Dav. Sil. Mon. (vol. iii), p. 190, pl. xxiv, figs. 27, 28	...	...	...	...	...	...	...	×
— *Girvaniensis*, Dav. Sil. Sup. (vol. v), p. 155, pl. x, fig. 26	...	...	...	...	...	...	...	×
— *Glassiana*, Dav. (as *Atrypa depressa*, Sow.). Sil. Mon. (vol. iii), p. 123, pl. xii, figs. 11—15; pl. xiii, fig. 6. Sil. Sup. (vol. v), p. 155, pl. x, fig. 22. (The name *Glassii* having been already employed, the designation *Glassiana* has been given to the Silurian species)	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
RHYNCHONELLA *Jackii*, Dav. Sil. Sup. (vol. v), p. 158, pl. ix, fig. 3								
— *Lewisii*, Dav. Sil. Mon. (vol. iii), p. 180, pl. xxiii, figs. 25—28	...	...	...	...	...	...	...	×
— *Llandoveriana*, Dav. Sil. Mon. (vol. iii), p. 184, pl. xxiv, figs. 8—13. Sil. Sup. (vol. v), p. 157, pl. x, figs. 32—37	...	...	...	...	...	...	...	×
— *Lapworthi*, Dav. Sil. Sup. (vol. v), p. 154, pl. x, fig. 7	...	...	...	...	...	...	...	×
— *Maccoyana*, Dav. Sil. Mon. (vol. iii), pl. xxv, figs. 17—19 (not 16, or pl. xxvi, figs. 1—3). Sil. Sup. (vol. v), p. 161, pl. viii, fig. 33	...	...	...	...	...	...	...	×
— *nasuta*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 173, pl. xxiii, fig. 19. Sil. Sup. (vol. v), p. 160, pl. x, figs. 20, 21?	...	...	...	...	...	...	...	×
— *nana*, Salter. Dav. Sil. Mon. (vol. iii), p. 192, pl. xxiv, fig. 26	...	...	...	...	...	...	...	×
— *nucula*, Sow. Dav. Sil. Mon. (vol. iii), p. 181, pl. xxiv, figs. 1—7. Sil. Sup. (vol. v), p. 157, pl. x, figs. 27—29	...	...	...	...	...	...	...	×
— *æmula*, Salter. Dav. Sil. Mon. (vol. iii), p. 188, pl. xxiv, fig. 21. Sil. Sup. (vol. v), p. 160, pl. x, fig. 17?	...	...	...	...	...	...	...	×
— *Pentlandica*, Haswell. Dav. Sil. Mon. (vol. iii), p. 187, pl. xxii, figs. 9—19	...	...	...	...	...	...	...	×
— *Portlockiana*, Dav. Sil. Mon. (vol. iii), p. 189, pl. xxiv, figs. 23—25. Sil. Sup. (vol. v), p. 159, pl. x, figs. 12—14	...	...	...	...	...	...	...	×
— *Peachii*, Dav. Sil. Sup. (vol. v), p. 201, pl. xi, fig. 25	...	...	...	...	...	...	...	×
— *Stricklandii*, Sow. Dav. Sil. Mon. (vol. iii), p. 166, pl. xxi, figs. 1—6 and 28	...	...	...	...	...	...	...	×
— *Salteri*, Dav. Sil. Mon. (vol. iii), p. 188, pl. xxiv, figs. 19, 20	...	...	...	...	...	...	...	×
— *Scotica*, Dav. Sil. Sup. (vol. v), p. 201, pl. xi, fig. 26	...	...	...	...	...	...	...	×
— *Shallockiensis*, Dav. Sil. Sup. (vol. v), p. 154, pl. x, fig. 19	...	...	...	...	...	...	...	×
— *tripartita*, Sow. Dav. Sil. Mon. (vol. iii), p. 185, pl. xxiv, figs. 15, 16	...	...	...	...	...	...	...	×
— *Thomsoni*, Dav. Sil. Mon. (vol. iii), p. 186, pl. xxiv, fig. 18	...	...	...	...	...	...	...	×
— *Wilsoni*, Sow. Dav. Sil. Mon. (vol. iii), p. 167, pl. xxiii, figs. 1—9. Sil. Sup., p. 156	...	...	...	...	...	...	...	×
— — var. *Davidsoni*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 172, pl. xxiii, figs. 11—14	...	...	...	...	...	...	...	×
— — var. *sphæroidalis*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 173, pl. xxiii, fig. 10	...	...	...	...	...	...	...	×
— *Weaveri*, Salter. Dav. Sil. Mon. (vol. iii), p. 185, pl. xxiv, fig. 14. Sil. Sup. (vol. v), p. 158, pl. x, fig. 24	...	...	...	...	...	...	...	×
SKENIDIUM *arcola*, Quenstedt. Dav. Dev. Sup. (vol. v), p. 49, pl. iii, figs. 11—14	...	...	...	...	...	...	×	
— *Lewisii* (*Orthis*), Dav. Sil. Mon. (vol. iii), p. 208, pl. xxv, figs. 4, 9; and Sil. Sup. (vol. v), p. 173	...	...	...	...	...	...	...	×
— — var. *Woodlandiense*, Dav. Sil. Sup. (vol. v), p. 174, pl. xi, figs. 1, 2	...	...	...	...	...	...	...	×
— ? — var. *Hughesi* (*Orthis*), Dav. Sil. Mon. (vol. iii), p. 254, pl. xxxviii, fig. 26. Sil. Sup. (vol. v), p. 174	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
Skenidium *Grayiæ*, Dav. Sil. Sup. (vol. v), p. 175, pl. xi, figs. 3—5	...	...	...	...	...	...	...	×
— ? *Shallockiensis*, Dav. Sil. Sup. (vol. v), p. 174, pl. xi, figs. 6, 7	...	...	...	...	...	...	...	×
Orthisina *adscendens*, Pander. Dav. Sil. Mon. (vol. iii), p. 278, pl. xlix, figs. 27—29. Sil. Sup. (vol. v), p. 175, pl. xvi, figs. 16—18	...	...	...	...	...	...	...	×
Orthis *resupinata*, Martin. Dav. Carb. Mon. (vol. ii), p. 130, pl. xxix, figs. 1—6; pl. xxx, figs. 1—5. Carb. Sup. (vol. iv), p. 294	...	...	...	...	...	×		
— *Keyserlingiana*, de Kon. Dav. Carb. Mon. (vol. ii), p. 132, pl. xxviii, fig. 14	...	...	...	...	...	×		
— *Michelini*, L'Eveillé. Dav. Carb. Mon. (vol. ii), p. 132, pl. xxx, figs. 6—12. Carb. Sup. (vol. iv), p. 292, pl. xxxiv, figs. 15—17	...	...	...	...	...	×		
— ? *antiquata*, Phil. Dav. Carb. Mon. (vol. ii), p. 135, pl. xxviii, fig. 15; and p. 229	...	...	...	...	...	×		
— *arcuata*, Phil. Dav. Dev. Mon. (vol. iii), p. 93, pl. xvii, figs. 13, 14	...	...	...	...	...	...	×	
— *Eifliensis*, de Vern. Dav. Dev. Sup. (vol. v), p. 50, pl. iii, fig. 16	...	...	...	...	...	...	×	
— *granulosa*, Phil. Dav. Dev. Mon. (vol. iii), p. 92, pl. xvii, fig. 24	...	...	...	...	...	...	×	
— *hipparionix*, Vanuxem. Dav. Dev. Mon. (vol. iii), p. 90, pl. xvii, figs. 8—11	...	...	...	...	...	...	×	
— *interlineata*, Sow. Dav. Dev. Mon. (vol. iii), p. 91, pl. xvii, figs. 18—23	...	...	...	...	...	...	×	
— *Pengelliana*, Dav. Dev. Sup. (vol. v), p. 51, pl. iii, fig. 19	...	...	...	...	...	...	×	
— *striatula*, Schl. Dav. Dev. Mon. (vol. iii), p. 87, pl. xvii, figs. 4—7	...	...	...	...	...	...	×	
— *tetragona*, de Vern. Dav. Dev. Sup. (vol. v), p. 51, pl. iii, fig. 17	...	...	...	...	...	...	×	
— ? (or Strophomena) *Champernowni*, Dav. Dev. Sup. (vol. v), p. 52, pl. iii, fig. 18	...	...	...	...	...	...	×	
— *Hamoni*, Rouault. Dav. Bud. Salt. Mon. (vol. iv), p. 344, pl. xxxviii, fig. 20	...	...	...	...	...	...	×	
— *Monnieri*, Rouault (=*O. Vicaryi*, Dav.). Bud. Salt. Mon. (vol. iv), p. 345, pl. xl, figs. 1—8	...	...	...	...	...	...	×	
— *hipparionyx?* Vanuxem. Dav. Dev. Mon. (vol. iii), p. 90, pl. xvii, figs. 8—11. Dav. Bud. Salt. Mon. (vol. iv), p. 347, pl. xxxix, fig. 1	...	...	...	...	...	...	×	
— *alata*, Sow. Dav. Sil. Mon. (vol. iii), p. 232, pl. xxxiii, figs. 17—22	...	...	...	...	...	...	...	×
— *Actoniæ*, Sow. Dav. Sil. Mon. (vol. iii), p. 252, pl. xxxvi, figs. 5—17. Sil. Sup. (vol. v), p. 190, pl. xi, fig. 12	...	...	...	...	...	...	...	×
— *alternata*, Sow. Dav. Sil. Mon. (vol. iii), p. 264, pl. xxxi, figs. 1—8. Sil. Sup. (vol. v), p. 187, pl. xiv, figs. 1—6	...	...	...	...	...	...	...	×
— *biloba*, Linné. Dav. Sil. Mon. (vol. iii), p. 206, pl. xxvi, figs. 10—15. Sil. Sup. (vol. v), p. 180	...	...	...	...	...	...	...	×
— *Bouchardi*, Dav. Sil. Mon. (vol. iii), p. 209, pl. xxvi, figs. 16—23	...	...	...	...	...	...	...	×
— *basalis*, Dalman. Dav. Sil. Mon. (vol. iii), p. 217, pl. xxvii, figs. 10, 11	...	...	...	...	...	...	...	×
— *Bailyana*, Dav. Sil. Mon. (vol. iii), p. 223, pl. xxix, figs. 19, 20	...	...	...	...	...	...	...	×
— *Budleyensis*, Dav. (under the mistaken name of *O. redux*, Barrande). Dav. Sil. Mon. (vol. iii), p. 224, pl. xxviii, figs. 6—9. Bud.-Sal. Mon. (vol. iv), p. 358, pl. xlii, figs. 16—25	...	...	...	...	...	...	...	×
— *Berthosi*, var. *Cornubiecnis*, Tromedin. Dav. Bud. Salt. Mon. (vol. iv), pl. xlii, figs. 14, 15	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
ORTHIS *Berthosi*, var. *erratica*. Dav. Sil. Mon. (vol. iii), p. 233, pl. xxxii, figs. 21—28. Bud. Salt. Mon. (vol. iv), p. 356, pl. xli, figs. 1—9	...	...	...	...	...	...	...	×
— *biforata*, Schl. Dav. Sil. Mon. (vol. iii), p. 268, pl. xxxviii, figs. 11—25. Sil. Sup. (vol. v), p. 181	...	...	...	...	...	...	...	×
— *Balcletchiensis*, Dav. Sil. Mon. (vol. iii, pl. xxvi), fig. 23. Sil. Sup. (vol. v), p. 176, pl. xiii, figs. 12—14	...	...	...	...	...	...	...	×
— *crispa*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 256, pl. xxxviii, figs. 5—10. Sil. Sup. (vol. v), p. 176, pl. xiii, figs. 7, 8	...	...	...	...	...	...	...	×
— *crassa*, Lindström. Dav. Sil Mon. (vol. iii), p. 213, pl. xxvii, figs. 17—19	...	...	...	...	...	...	...	×
— *canaliculata*, Lindström. Dav. Sil. Mon. (vol. iii), p. 218, pl. xxvii, figs. 12, 13	...	...	...	...	...	...	...	×
— *Carausii*, Salter. Dav. Sil. Mon. (vol. iii), p. 229, pl. xxxiii, figs. 1—7. Sil. Sup. (vol. v), p. 182, pl. xiv, figs. 21—27	...	...	...	...	...	...	...	×
— *calligramma*, Dalman. Dav. Sil. Mon. (vol. iii), p. 240, pl. xxxv, figs. 1—17. Sil. Sup. (vol. v), p. 181, pl. xiii, figs. 23—26	...	...	...	...	...	...	...	×
— — var. *Davidsoni*, de Vern. Dav. Sil. Mon. (vol. iii), p. 240, pl. xxxv, figs. 18, 19	...	...	...	...	...	...	...	×
— — var. *virgata*, Salter. Dav. Sil. Mon. (vol. iii), p 240, pl. xxxv, figs. 23, 24	...	...	...	...	...	...	...	×
— — var. *Scotica*, Salter. Dav. Sil. Mon. (vol. iii), p. 140, pl. xxxv, figs. 20, 22	...	...	...	...	...	...	...	×
— ? *Crofti*, Dav. Sil. Sup. (vol. v), p. 179, pl. xiii, figs. 18, 19	...	...	...	...	...	...	...	×
— *confinis*, Salter. Dav. Sil. Mon. (vol. iii), p. 266, pl. xxxvi, figs. 1—4 Sil. Sup. (vol. v), p. 180	...	...	...	...	...	...	...	×
— *elegantula*, Dal. Dav. Sil. Mon. (vol. iii), p. 211, pl. xxvii, figs. 1—9. Sil. Sup. (vol. v), p. 178	...	...	...	...	...	...	...	×
— *elegantulina*, Dav. Sil. Sup. (vol. v), p. 219, pl. xiii, fig. 17	...	...	...	...	...	...	...	×
— *flabellulum*, Sow. Dav. Sil. Mon. (vol. iii), p. 248, pl. xxxiv, figs. 1—12. Sil. Sup. (vol. v), p. 179, pl. xiii, figs. 3—6, and 20, 21	...	...	...	...	...	...	...	×
— *fallax*, Salter. Dav. Sil. Mon. (vol. iii), p. 223, pl. xxxi, figs. 9—11	...	...	...	...	...	...	...	×
— *Girvaniensis*, Dav. Sil. Mon. (vol. iii), p. 216, pl. xxviii, fig. 10	...	...	...	...	...	...	...	×
— ? *Hirmantensis*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 261, pl. xxxii, figs. 5—9. Sil. Sup. (vol. v), p. 184, pl. xi, figs. 8—11	...	...	...	...	...	...	...	×
— *hybrida*, Sow. Dav. Sil. Mon. (vol. iii), p. 214, pl. xxvii, figs. 15, 16	...	...	...	...	...	...	...	×
— *Hicksii*, Salter. Dav. Sil. Mon. (vol. iii), p. 230, pl. xxxiii, figs. 13—16. Sil. Sup. (vol. v), p. 184	...	...	...	...	...	...	...	×
— *intercostata*, Portlock. Dav. Sil. Mon. (vol. iii), p. 236, pl. xxxviii, figs. 1—4	...	...	...	...	...	...	...	×
— *Jonesi*, Dav. Sil. Sup. (vol. v), p. 190, pl xi, figs. 15—17	...	...	...	...	...	...	...	×
— ? *Kilbucoensis*, Dav. Sil. Sup. (vol. v), p. 188, pl. xiii, figs. 1, 2	...	...	...	...	...	...	...	×
— *Lapworthi*, Dav. Sil. Sup. (vol. v), p. 176, pl. xiii, figs. 9, 10	...	...	...	...	...	...	...	×
— *lunata*, Dav. Sil. Mon. (vol. iii), p. 215, pl. xxviii, figs. 1—5	...	...	...	...	...	...	...	×
— *lenticularis*, Wahl.? Dav. Sil. Mon. (vol. iii), p. 230, pl. xxxiii, figs. 22—28	...	...	...	...	...	...	...	×
— *Menapiæ*, Hicks. Dav. Sil. Mon. (vol. iii), p. 228, pl. xxxiii, figs. 8—12	...	...	...	...	...	...	...	×
— *Mullockiensis*, Dav. Sil. Mon. (vol. iii), p. 221, pl. xxix, figs. 14—18. Sil. Sup. (vol. v), p. 180, pl. xvi, figs. 14, 15	...	...	...	...	...	...	...	×
— *nina*, Dav. Sil. Sup. (vol. v), p. 177, pl. xiii, fig. 11	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
ORTHIS *æquivalvis*, Dav. Sil. Mon. (vol. iii), p. 263, pl. xxx, figs. 9, 10								×
— *polygramma*, var. *pentlandica*, Dav. Sil. Mon. (vol. iii), p. 219, pl. xxix, figs. 1—10. Sil. Sup. (vol. v), p. 179								×
— *pulvinata*, Salter. Bud. Salt. Mon. (vol. iv), p. 357, pl. xli, figs. 10, 11								×
— *plicata*, Sow. Dav. Sil. Mon. (vol. iii), p. 245, pl. xxxv, figs. 25, 26; pl. xxxvii, fig. 1. Sil. Sup. (vol. v), p. 182, pl. xiii, fig. 27								×
— *protensa*, Sow. Dav. Sil. Mon. (vol. iii), p. 257, pl. xxxvi, figs. 24—30								×
— *porcata*, M'Coy. Sil. Mon. (vol. iii), p. 250, pl. xxxi, figs. 12—20; pl. xlvi, fig. 4								×
— *Philipi*, Dav. Sil. Sup. (vol. v), p. 188, pl. xi, figs. 13, 14								×
— *patera*, Salter. Dav. Sil. Mon. (vol. iii), p. 267, pl. xxx, figs. 1—8								×
— *reversa*, Dav. Sil. Mon. (vol. iii), p. 220, pl. xxix, figs. 11—13. Sil. Sup. (vol. v), p. 180, pl. xvi, fig. 13								×
— *rustica*, Sow. Dav. Sil. Mon. (vol. iii), p. 238, pl. xxxiv, figs. 13—17. Sil. Sup. (vol. v), p. 178, pl. xxxiv, figs. 13—22								×
— — var. *rigida*, Dav. Sil. Mon. (vol. iii), p. 238, pl. xxxiv, figs. 18, 19								×
— — var. *Walsalliensis*, Dav. Sil. Mon. (vol. iii), p. 238, pl. xxxiv, figs. 20—22								×
— *retrorsistria*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 265, pl. xxxvi, figs. 39—42 (only). Sil. Sup. (vol. v), p. 185, pl. xiv, figs. 7—16								×
— *Rankini*, Dav. Sil. Sup. (vol. v), p. 190, pl. xi, figs. 17—19								×
— *Sowerbyana*, Dav. Sil. Mon. (vol. iii), p. 247, pl. xxxv, figs. 27—31. Sil. Sup. (vol. v), p. 178								×
— *simplex*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 255, pl. xxxii, figs. 10, 11								×
— *Salteri*, Dav. Sil. Mon. (vol. iii), p. 255, pl. xxxvi, figs. 31—34								×
— *sagittifera*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 260, pl. xxxvi, figs. 18—23. Sil. Sup. (vol. v), p. 181, pl. xiii, fig. 29								×
— *sarmentosa*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 262, pl. xxxvi, figs. 35—38. Sil. Sup. (vol. v), p. 189								×
— *testudinaria*, Dalman. Dav. Sil. Mon. (vol. iii), p. 226, pl. xxviii, figs. 13—16, 22—24 (not 13—15, 17—21). Bud. Salt. Mon. (vol. iv), pl. xlii, fig. 26. Sil. Sup. (vol. v), p. 178, pl. xiii, figs. 30, 31								×
— *turgida*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 258, pl. xxxii, figs. 12—20. Sil. Sup. (vol. v), p. 187, pl. xiv, figs. 17—20								×
— *tricenaria*, Conrad. Dav. Sil. Mon. (vol. iii), p. 276, pl. xxxviii, fig. 28								×
— *unguis*, Sow. Dav. Sil. Mon. (vol. iii), p. 257, pl. xxxvii, figs. 16—22. Sil. Sup. (vol. v), p. 177, pl. xiii, fig. 28?								×
— *Valpyana*, Dav. Sil. Mon. (vol. iii), p. 235, pl. xxxii, figs. 29—33								×
— *vespertilio*, Sow. Dav. Sil. Mon. (vol. iii), p. 236, pl. xxx, figs. 11—21								×
STREPTORHYNCHUS *pelargonatus*, Schl. Dav. Perm. Mon. (vol. ii), p. 32, pl. ii, figs. 33—42. Perm. Sup. (vol. iv), pl. xxx, fig. 3					×			

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
STREPTORHYNCHUS *crenistria*, Phillips. Dav. Carb. Mon. (vol. ii), pp. 124, 228, pl. xxvi, figs. 1—6; pl. xxvii, figs. 1—5, and 10? Carb. Sup. (vol. iv), p. 288, pl. xxxvii, figs. 1—5; and Bud. Salt. Mon. (vol. iv), p. 351, pl. xxxix, fig. 3	...	...	...	...	...	×	×	
— — var. *arachnoidea*, Phillips. Dav. Carb. Mon. (vol. ii), p. 127, pl. xxv, figs. 19—21; pl. xxvi, figs. 2—4 (lower figures), 5, 6. Dav. Dev. Mon. (vol. iii), p. 81, pl. xviii, figs. 4, 7	...	...	...	...	...	×	×	
— — var. *Kellii*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 127, pl. xxvii, fig. 8	...	...	...	...	...	×		
— — var. *cylindrica*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 128, pl. xxvii, fig. 9. Carb. Sup. (vol. iv), p. 290, pl. xxxvii, figs. 6, 7	...	...	...	...	...	×		
— — var. *radialis*, Phil. Dav. Carb. Mon. (vol. ii), p. 129, pl. xxv, figs. 16—18	...	...	...	...	..	×		
— — var. *senilis*, Phillips. Dav. Carb. Mon. (vol. ii), pl. xxvii, figs. 2—10; and Carb. Sup. (vol. iv), p. 290	...	...	...	...	...	×		
— *gigas*, M'Coy. Dav. Dev. Mon. (vol. iii), p. 83, pl. xvi, figs. 1—3	...	...	...	...	...	...	×	
— ? *persarmentosus*, M'Coy. Dav. Dev. Mon. (vol. iii), p. 84, pl. xvi, fig. 5	...	...	...	...	...	..	×	
— *umbraculum*, Schl. Dav. Dev. Mon. (vol. iii), p. 76, pl. xvi, fig. 6; and pl. xviii, figs. 1—5. Dev. Sup. (vol. v), pl. iii, fig. 20	...	...	...	...	..	...	×	
— *nasutus*, Lindström (as *Cyrtia?*). Dav. Sil. Mon. (vol. iii), p. 201, pl. xxv, figs. 1, 2. Sil. Sup. (vol. v), p. 172	...	.	...	...	...	...	...	×
STROPHOMENA *rhomboidalis*, Wilckens (as *St. analoga*), Phillips. Dav. Carb. Mon. (vol. ii), p. 119, pl. xxviii, figs. 1—13. Carb. Sup. (vol. iv), p. 291, pl. xxxvi, fig. 23. Dev. Mon. (vol. iii), p. 76, pl. x7, figs. 15—17. Sil. Mon. (vol. iii), p. 281, pl. xxxix, figs. 1—21; pl. xliv, fig. 1. Sil. Sup. (vol. v), p. 192	..	...	...	...	...	×	×	×
— — var. *nodulosa*, Phillips. Dav. Dev. Sup. (vol. v), p. 52, pl. iii, fig. 15	...	...	...	..	...	..	×	
— *Vicaryi*, Dav. Bud. Salt. Mon. (vol. iv), p. 348, pl. xxxix, fig. 8	...	...	...	...	...	...	×	
— *Rouaulti*, Dav. Bud. Salt. Mon. (vol. iv), p. 348, pl. xxxix, fig. 9	...	...	...	..	...	...	×	
— *Edgelliana*, Dav. Bud. Salt. Mon. (vol. iv), p. 349, pl. xxxix, figs. 5—7	...	...	...	...	...	...	×	
— *Budleighensis*, Dav. Bud. Salt. Mon. (vol. iv), p. 349, pl. xxxix, fig. 4	...	...	...	...	...	...	×	
— *Etheridgi*, Dav. Bud. Salt. Mon. (vol. iv), p. 350, pl. xxxix, figs. 10, 11	...	...	...	..	...	...	×	
— Sp. Dav. Bud. Salt. Mon. (vol. iv), p. 350, pl. xxxix, fig. 1	...	...	...	..	..	..	×	
— Sp. Dav. Bud. Salt. Mon. (vol. iv), p. 351, pl. xxxix, fig. 2	...	...	...	...	...	..	×	
— *arenacea*, Salter. Dav. Sil. Mon. (vol. iii), p. 296, pl. xlii, figs. 6—8. Sil. Sup. (vol. v), p. 197, pl. xvi, figs. 2—5	...	...	...	...	..	..	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
STROPHOMENA *antiquata*, Sow. Dav. Sil. Mon. (vol. iii), p. 299, pl. xliv, figs. 2—13 and 21, 22. Sil. Sup. (vol. v), p. 193, pl. xv, figs. 12—14								×
— *applanata*, Salter. Dav. Sil. Mon. (vol. iii), p. 308, pl. xliii, figs. 12—14								×
— *? bipartita*, Salter. Dav. Sil. Sup. (vol. v), p. 193, pl. xvi, figs. 9—12								×
— *corrugatella*, Dav. Sil. Mon. (vol. iii), p. 301, pl. xli, figs. 8—14. Sil. Sup. (vol. v), p. 192, pl. xv, figs. 23—26								×
— *compressa*, Sow. Dav. Sil. Mon. (vol. iii), p. 315, pl. xlvi, figs. 7—10								×
— *Callawayiana*, Dav. Sil. Sup. (vol. v), p. 193, pl. xvi, figs. 6, 7								×
— *Dayi*, Dav. Sil. Mon. (vol. iii), p. 292, pl. xli, fig. 7								×
— *deltoidea*, Conrad. Dav. Sil. Mon. (vol. iii), p. 292, pl. xlii, figs. 1—5, pl. xxxix, fig. 22. Sil. Sup. (vol. v), p. 197, pl. xv, figs. 16—22								×
— — var. *undata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 295, pl. xxxix, figs. 23, 24								×
— *euglypha*, Hisinger. Dav. Sil. Mon. (vol. iii), p. 288, pl. xl, figs. 1—5								×
— *expansa*, Sow. Sil. Mon. (vol. iii), p. 312, pl. xlv, figs. 1—10. Sil. Sup. (vol. v), p. 194, pl. xv, figs. 1—5								×
— *Fletcheri*, Dav. Sil. Mon. (vol. iii), p. 317, pl. xlvii, figs. 5, 6								×
— *filosa*, Dav. Sil. Mon. (vol. iii), p. 307, pl. xliv, figs. 14—20								×
— *funiculata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 290, pl. xl, figs. 9—13								×
— *grandis*, Sow. Dav. Sil. Mon. (vol. iii), p. 311, pl. xlvi, figs. 1—3, and 5, 6. Sil. Sup. (vol. v), p. 195, pl. xv, fig. 6								×
— *Hollii*, Dav. Sil. Mon. (vol. iii), p. 303, pl. xlii, figs. 18, 19								×
— *Hendersoni*, Dav. Sil. Mon. (vol. iii), p. 311, pl. xliii, fig. 15								×
— *imbrex*, var. *semiglobosa*, Dav. Sil. Mon. (vol. iii), p. 286, pl. xli, figs. 1—6. Sil. Sup. (vol. v), p. 195, pl. xv, figs. 9—11								×
— *Jukesii*, Dav. Sil. Mon. (vol. iii), p. 296, pl. xxxvii, figs. 23—26								×
— *Llandeiloensis*, Dav. Sil. Mon. (vol. iii), p. 316, pl. xlvi, figs. 11—14								×
— *Orbignyi*, Dav. Sil. Mon. (vol. iii), p. 306, pl. xlii, figs. 12—14								×
— *ornatella*, Salter. Dav. Sil. Mon. (vol. iii), p. 309, pl. xliii, figs. 16—20								×
— *pecten*, Linné. Dav. Sil. Mon. (vol. iii), p. 304, pl. xliii, figs. 1—11. Sil. Sup. (vol. v), p. 194, pl. xv, fig. 15								×
— *retroflexa*, Salter. Dav. Sil. Mon. (vol. iii), p. 298, pl. xlii, figs. 15—17. Sil. Sup. (vol. v), p. 195, pl. xv, figs. 7, 8								×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
STROPHOMENA *simulans*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 297, pl. xlii, figs. 9, 10	...	...	...	...	...	...	...	×
— *siluriana*, Dav. Sil. Mon. (vol. iii), p. 303, pl. xlvii, figs. 1—4	...	...	...	...	...	...	...	×
— *Shallockiensis*, Dav. Sil. Sup. (vol. v), p. 192, pl. xi, figs. 20, 21, pl. xii, fig. 30; and pl. xvi, fig. 8	...	...	...	...	...	...	...	×
— *ungula*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 285, pl. xlii, figs. 20, 21	...	...	...	...	...	...	...	×
— *Walmstedti*, Lindström. Dav. Sil. Mon. (vol. iii), p. 290, pl. xl, figs. 6—8	...	...	...	...	...	...	...	×
— *Waltoni*, Dav. Sil. Mon. (vol. iii), p. 310, pl. xlii, fig. 11. Sil. Sup. (vol. v), p. 195	...	...	...	...	...	...	...	×
LEPTÆNA ? *Davidsoni*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 91, pl. x, figs. 37—30	...	...	...	×				
— ? *Pearcei*, Dav. Ool. Mon. (vol. i), p. 17, pl. i, fig. 19 (not a Brachiopod, perhaps referable to the genus *Monotis*). Ool. Sup. (vol. iv), p. 93	...	...	...	×				
— ? *granulosa*, Dav. Ool. Mon. (vol. i), p. 18, pl. i, fig. 20 (see *Terebratulina ? Deslongchampsi*, Dav.). Ool. Sup. (vol. iv), p. 94	...	...	...	×				
— *liasiana*, Bouchard. Dav. Ool. Mon. (vol. i), p. 18, pl. i, fig. 21, is a *Koninchella*. Ool. Sup. (vol. iv), p. 93. See Appendix to Sup. (vol. v), p. 278, pl. xx, fig. 18	...	...	...	×				
— *rostrata*, E. Desl. Dav. Ool. Sup. (vol. iv), p. 92, pl. x, fig. 30, is a *Koninchella*. See Appendix to Sup. (vol. v), p. 278	...	...	...	×				
— *Bouchardii*, Dav. Ool. Mon. (vol. i), p. 19, pl. i, fig. 22, is a *Koninchella*. See Appendix to Sup. (vol. v), p. 278	...	...	...	×				
— ? *Moorei*, Dav. Ool. Mon. (vol. i), p. 17, pl. i, fig. 18	...	...	...	×				
— ? *interstrialis*, Phil. Dav. Dev. Mon. (vol. iii), p. 85, pl. xviii, fig. 15—18	...	...	...	...	...	...	×	
— ? *laticosta*, Conrad. Dav. Dev. Mon. (vol. iii), p. 87, pl. xvii, figs. 1—3	...	...	...	...	...	...	×	
— ? *irregularis*, Roemer. Dav. Appendix to Sup. (vol. v), p. 285, pl. xx, fig. 23	...	...	...	...	...	...	×	
— ? *Looiensis*, Dav. Dev. Mon. (vol. iii), p. 84, pl. xviii, figs. 13, 14. Dev. Sup. (vol. v), p. 53	...	...	...	...	...	...	×	
— ? *nobilis*, M'Coy. Dav. Dev. Mon. (vol. iii), p. 86, pl. xviii, figs. 19—21. Dev. Sup. (vol. v), p. 53	...	...	...	...	...	...	×	
— *Etheridgei*, Dav. Sil. Sup. (vol. v), p. 170, pl. xii, figs. 11, 12	...	...	...	...	...	...	...	×
— *Grayæ*, Dav. Sil. Sup. (vol. v), p. 171, pl. xii, figs. 23—25	...	...	...	...	...	...	...	×
— *lævigata*, Sow. Dav. Sil. Mon. (vol. iii), p. 328, pl. xlix, figs. 1—12	...	...	...	...	...	...	...	×
— *Llandeiolensis*, Dav. Sil. Sup. (vol. v), p. 171, pl. xii, figs. 26—29	...	...	...	...	...	...	...	×
— *quinquecostata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 322, pl. xlviii, figs. 23—27. Sil. Sup. (vol. v), p. 169, pl. xii, fig. 13	...	...	...	...	...	...	...	×
— *segmentum*, Angelin. Dav. Sil. Mon. (vol. iii), p. 321, pl. xlviii, figs. 28—30	...	...	...	...	...	...	...	×
— — var. *cornuta*, Dav. Sil. Sup. (vol. v), p. 166, pl. xii, figs. 1—3	...	...	...	...	...	...	...	×

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
LEPTÆNA *sericea*, Sow. Dav. Sil. Mon. (vol. iii), p. 323, pl. xlviii, figs. 10—19. Sil. Sup. (vol. v), p. 169, pl. xii, figs. 8—10	...	...	...	...	...	...	...	×
— — var. *rhombica*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 325, pl. xlviii, figs. 20—22. Sil. Sup. (vol. v), p. 169, pl. xii, figs. 4—7	...	...	...	...	...	...	...	×
— — var. *scissa*, Salter. Dav. Sil. Mon. (vol. iii), p. 325, pl. xlvii, figs. 21—25. Sil. Sup. (vol. v), p. 170, pl. xii, fig. 22	...	...	...	...	...	...	...	×
— *tenuicincta*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 326, pl. xlvii, figs. 7—18. Sil. Sup. (vol. v), p. 168; and pl. xii, figs. 17—21	...	...	...	...	...	...	...	×
— *tenuissime-striata*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 330, pl. xlix, figs. 20—22	...	...	...	...	...	...	...	×
— *transversalis*, Wahl. Dav. Sil. Mon. (vol. iii), p. 318, pl. xlviii, figs. 1—9	...	...	...	...	...	...	...	×
— *Youngiana*, Dav. Sil. Mon. (vol. iii), p. 320, pl. xlvii, figs. 19, 20. Sil. Sup. (vol. v), p. 168, pl. xii, figs. 14—16	...	...	...	...	...	...	...	×
STROPHALOSIA *Goldfussi*, Münster. Dav. Perm. Mon. (vol. ii), p. 39, pl. iii, figs. 1—10. Carb. Mon. (vol. ii), p. 269	...	...	...	...	×			
— — var. *Lewisiana*, de Kon. Dav. Perm. Mon. (vol. ii), p. 43, pl. iii, figs. 19—22. Carb. Mon., pl. liv, fig. 43	...	...	...	...	×			
— *lamellosa*, Geinitz. Dav. Perm. Mon. (vol. ii), p. 44, pl. iii, figs. 24—41. Carb. Mon. (vol. ii), p. 269	...	...	...	...	×			
PRODUCTUS *horridus*, J. Sow. Dav. Permian Mon. (vol. ii), p. 33, pl. iv, figs. 13—26. Carb. Mon. (vol. ii), pl. liv, fig. 44	...	...	...	...	×			
— *latirostratus*, Howse = *umbonellatus*, King. Dav. Permian Mon. (vol. ii), p. 36, pl. iv, figs. 1—12	...	...	...	...	×			
— *striatus*, Fischer. Dav. Carb. Mon. (vol. ii), p. 139, pl. xxxiv, figs. 1—5; and p. 232, pl. liii, fig. 4	...	...	...	...	...	×		
— *giganteus*, Martin. Dav. Carb. Mon. (vol. ii), p. 141, pl. xxxvii, figs. 1—4; pl. xxxviii, fig. 1; pl. xxxix, figs. 1—5; pl. xl, figs. 1—3. Carb. Sup. (vol. iv), p. 297, pl. xxxvi, figs. 1 and 21	...	...	...	...	...	×		
— — var. *hemisphærica*, Sow. Dav. Carb. Mon. (vol. ii), p. 144, pl. xl, figs. 4—9	...	...	...	...	...	×		
— *latissimus*, J. Sow. Dav. Carb. Mon. (vol. ii), p. 145, pl. xxxv, figs. 1—4. Carb. Sup. (vol. iv), p. 297	...	...	...	...	...	×		
— *humerosus*, Sow. Dav. Carb. Mon. (vol. ii), p. 147, pl. xxxvi, figs. 1, 2 (internal cast) = shell *P. sub-lævis*, p. 177, pl. xxxi, figs. 1, 2; pl. xxxii, fig. 1; pl. li, figs. 1, 2, p. 234. Carb. Sup. (vol. iv), p. 306	...	...	...	...	...	×		
— *cora*, d'Orb. Carb. Mon. (vol. ii), p. 148, pl. xxxvi, fig. 4; and pl. xlii, fig. 9. Carb. Sup. (vol. iv), p. 299	...	...	...	...	...	×		
— *semireticulatus*, Martin. Dav. Carb. Mon., p. 149, pl. xliii, figs. 1—11; and pl. xliv, figs. 1—4, var. *Martini*, pl. xliii, fig. 6. Carb. Sup. (vol. iv), pp. 297, 307; pl. xxxv, figs. 1, 2; pl. xxxvi, figs. 12, 17	...	...	...	...	...	×		

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
PRODUCTUS *costatus*, Sow. Dav. Carb. Mon. (vol. ii), p. 152, pl. xxxii, figs. 2—9. Carb. Sup. (vol. iv), p. 298, pl. xxxvi, figs. 9, 18—20						×		
— — var. *muricata*, Phillips. Dav. Carb. Mon. (vol. ii), p. 153, pl. xxxii, figs. 10—14						×		
— *longispinus*, Sow. Dav. Carb. Mon. (vol. ii), p. 154, pl. xxxv, figs. 5—17. Carb. Sup., p. 298, pl. xxxvi, figs. 14—16.? Dav. Dev. Mon. (vol. iii), p. 103, pl. xx, fig. 7						×		
— *sinuatus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 157, pl. xxxiii, figs. 8—11. Carb. Sup. (vol. iv), p. 299						×	×	
— *margaritaceus*, Phil. Dav. Carb. Mon. (vol. ii), p. 159, pl. xliv, figs. 5—8						×		
— *arcuarius*, de Kon. Dav. Carb. Mon. (vol. ii), p. 160, pl. xxxiv, fig. 17								
— *carbonarius*, de Kon. Dav. Carb. Mon. (vol. ii), p. 160, pl. xxxiv, fig. 6. Carb. Sup. (vol. iv), p. 309, pl. xxxvi, figs. 7, 8						×		
— *undatus*, Def. Dav. Carb. Mon. (vol. ii), p. 161, pl. xxxiv, figs. 7—13. Carb. Sup. (vol. iv), p. 300						×		
— *Wrightii*, Dav. Carb. Mon. (vol. ii), p. 162, pl. xxxiii, figs. 6, 7						×		
— *proboscideus*, de Vern. Dav. Carb. Mon. (vol. ii), p. 163, pl. xxxiii, figs. 1—4. Carb. Sup. (vol. iv), p. 311, pl. xxxvi, fig. 13						×		
— *ermineus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 164, pl. xxxiii, fig. 5; and p. 233						×		
— *tessellatus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 165, pl. xxxiii, figs. 24, 25; pl. xxxiv, fig. 14. Carb. Sup. (vol. iv), p. 310, pl. xxxvi, figs. 3—5						×		
— *aculeatus*, Martin. Dav. Carb. Mon. (vol. ii), p. 166, 233, pl. xxxiii, figs. 16—20. Carb. Sup. (vol. iv), pp. 299, 311, pl. xxxvi, fig. 10						×		
— *Youngianus*, Dav. Carb. Mon. (vol. ii), pp. 167, 233, pl. xxxiii, figs. 21—23. Carb. Sup. (vol. iv), p. 299						×		
— *pustulosus*, Phillips. Dav. Carb. Mon. (vol. ii), p. 168, pl. xli, figs. 1—6; pl. xlii, figs. 1—4. Carb. Sup. (vol. iv), p. 300						×		
— *scabriculus*, Martin. Dav. Carb. Mon. (vol. ii), p. 169, pl. xlii, figs. 5—8. Carb. Sup. (vol. iv), pp. 300, 308, pl. xxxv, fig. 3; pl. xxxvi, fig. 22. Dev. Mon. (vol. iii), p. 103, pl. xx, figs. 3—5?						×	?	
— *fimbriatus*, Sow. Dav. Carb. Mon. (vol. ii), p. 171, pl. xxxiii, figs. 12—15; and pl. xliv, fig. 15. Carb. Sup. (vol. iv), p. 300						×		
— *punctatus*, Martin. Dav. Carb. Mon. (vol. ii), p. 172, pl. xliv, figs. 9—16. Carb. Sup. (vol. iv), p. 298						×		
— — var. *elegans*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 173, pl. xliv, fig. 15						×		
— *Keyserlingianus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 174, pl. xxxiv, figs. 15, 16						×		
— *spinulosus*, Sow. Dav. Carb. Mon. (vol. ii), p. 175, pl. xxxiv, figs. 18—21. Carb. Sup. (vol. iv), p. 299, pl. xxxvi, fig. 11						×		

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
PRODUCTUS *plicatilis*, Sow. Dav. Carb. Mon. (vol. ii), p. 176, pl. xxxi, figs. 3—5	...	...	...	...	...	×		
— *sub-lævis*, de Kon. (a synonym of *P. humerosus*). Dav. Carb. Mon. (vol. ii), pp. 177, 234, pl. xxxi, figs. 1, 2; pl. xxxii, fig. 1; pl. li, figs. 1, 2	...	...	...	...	...	×		
— *mesolobus*, Phillips. Dav. Carb. Mon. (vol. ii), p. 178, pl. xxxi, figs. 6—9. Carb. Sup. (vol. iv), p. 299	...	...	...	...	...	×		
— *marginalis*, de Kon. Dav. Carb. Mon. (vol. ii), p. 229, pl. liii, fig. 3	...	...	...	...	...	×		
— *Koninckianus*, de Verneuil. Dav. Carb. Mon. (vol. ii), p. 230, pl. liii, fig. 7	...	...	...	...	...	×		
— *undiferus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 230, pl. liii, figs. 5, 6	...	...	...	...	...	×		
— *Nystianus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 231, pl. liii, fig. 9	...	...	...	...	...	×		
— *Deshayesianus*, de Kon. Dav. Carb. Mon. (vol. ii), p. 232, pl. liii, figs. 11, 12	...	...	...	...	...	×		
— *complectens*, Etheridge. Dav. Carb. Sup. (vol. ii), p. 303, pl. xxxv, figs. 4—13	...	...	...	...	...	×		
— *Llangollensis*, Dav. (described as *Chonetes comoides*). Dav. Carb. Mon. (vol. ii), pp. 180, 277, pl. xlv, figs. 1—6 (not 7); pl. lv, figs. 9, 10. Carb. Sup. (vol. iv), p. 307	...	...	...	...	...	×		
— *Griffithianus*, de Kon. Dav. Carb. Sup. (vol. iv), p. 308, pl. xxxvi, fig. 6	...	...	...	...	...	×		
— *Carringtonianus*, Dav. Carb. Mon. (vol. ii), p. 274, pl. lv, fig. 5	...	...	...	...	...	×		
— *prælongus*, Sow. Dav. Dev. Mon. (vol. iii), p. 102, pl. xix, figs. 22—25	...	...	...	...	...	...	×	
— *subaculeatus*, Murch. Dav. Dev. Mon. (vol. iii), p. 99, pl. xx, figs. 1, 2. Dev. Sup. (vol. v), p. 54, pl. iii, fig. 22	...	...	...	...	...	...	×	
CHONETES *Davidsoni*, Schauroth. Dav. Perm. Sup. (vol. iv), p. 244, pl. xxx, figs. 1, 2	...	...	...	...	×			
— *comoides*, Sow. Dav. Carb. Mon. (vol. ii), pp. 180, 275, 276, pl. xlv, fig. 7 (not 1—6, which belongs to *Productus llangollensis*, Dav.), pl. lv, figs. 6, 7	...	...	...	...	...	×		
— *papilionacea*, Phillips. Dav. Carb. Mon. (vol. ii), p. 182, pl. xlvi, figs. 3, 6	...	...	...	...	...	×		
— *Dalmaniana*, de Kon. Dav. Carb. Mon. (vol. ii), p. 183, pl. xlvi, fig. 7	...	...	...	...	...	×		
— *Buchiana*, de Kon. Carb. Mon. (vol. ii), p. 184, pl. xlvii, figs. 1—7 and 28; and pl. lv, fig. 12; pl. lii, fig. 21	...	...	...	...	...	×		
— *Laguissiana*, de Kon. (as *C. Hardrensis*, Phil.). Dav. Carb. Mon. (vol. ii), p. 186, pl. xlvii, figs. 12—16 (17, 18, and 25?). Carb. Sup. (vol. iv), p. 312, pl. xxxiv, fig. 18. App. to Sup. (vol. v), p. 280, pl. xx, figs. 20, 21	...	...	...	...	...	×		
— *gibberula*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 188. Carb. Sup. (vol. iv), p. 313, pl. xxxiv, figs. 19, 20	...	...	...	...	...	×		
— *sub-minima*, M'Coy. Carb. Mon. (vol. ii), p. 188 (uncertain species)	...	...	...	...	...	×		
— *sulcata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 189 (uncertain species)	...	...	...	...	...	×		
— *volva*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 189 (uncertain species)	...	...	...	...	...	×		

CLISTENTERATA.	Recent.	Tertiary.	Cretaceous.	Jurassic.	Permian.	Carboniferous.	Devonian.	Silurian.
CHONETES *perlata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 189 (uncertain species)						×		
— *polita*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 190, pl. xlvii, figs. 8—11						×		
— *serrata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 191 (uncertain species)						×		
— *tuberculata*, M'Coy. Dav. Carb. Mon. (vol. ii), p. 191 (uncertain species)						×		
— *convoluta*, Phillips. Dav. Dev. Mon. (vol. iii), pl. xix, fig. 9 (not *C. hardrensis*). Dev. Sup. (vol. v), p. 55							×	
— *Hardrensis*, Phil. Dav. Dev. Mon. (vol. iii), p. 94, pl. xix, figs. 6—8 (not 9). Dev. Sup. (vol. v), p. 54, pl. iii, fig. 24							×	
— *minuta*, Goldf. Dav. Dev. Mon. (vol. iii), p. 96, pl. xix, figs. 10—12							×	
— ? *Phillipsii*, Dav. Dev. Sup. (vol. v), p. 54, pl. iii, fig. 23							×	
— *striatella*, Dalman = *C. lata*, Sow. Dav. Sil. Mon. (vol. iii), p. 331, pl. xlix, figs. 23—26								×
— *lepisma*, Sow. (not of Dalman). Dav. Sil. Mon. (vol. iii), p. 333, pl. xlix, figs. 13, 14								×
— *minima*, Sow. (as *L. Grayii*, Dav.). Dav. Sil. Mon. (vol. iii), p. 334, pl. xlix, figs. 15—19								×
AULACORHYNCHUS *Davidsoni*, Dittmar (as *Chonetes concentrica*, de Kon.). Dav. Carb. Mon. (vol. ii), p. 278, pl. lv, fig. 13. *Aulocorhynchus Davidsoni*, Appendix to Sup. (vol. v), p. 283, pl. xx, fig. 22						×		
ADDENDA.								
ATRYPA *latilinguis*, Dav. Dev. Sup. (vol. v), p. 41, pl. ii, fig. 9							×	
— *lens*, Dav. Dev. Mon. (vol. iii), p. 51, pl. x, fig. 1							×	
— ? *Scotica*, M'Coy. Dav. Sil. Mon. (vol. iii), p. 140, pl. xiii, fig. 31								×
DAVIDSONIA *Verneuilii*, Bouchard. Dav. Dev. Mon. (vol. iii), p. 74, pl. xi, figs. 13—16; pl. xv, fig. 18. Dev. Sup. (vol. v)							×	
ORTHIS *Edgelliana*, Salter. Dav. Sil. Mon. (vol. iii), p. 228, pl. xxxii, figs. 1—4								×
PRODUCTUS *Vicaryi*, Salter sp. Dav. Bud. Salt. Mon. (vol. iv), p. 351, pl. xxxix, figs. 14, 15							×	
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STROPHALOSIA *productoides*, Murchison. Dav. Dev. Mon. (vol. iii), p. 97, pl. xix, figs. 13—21							×	
RHYNCHONELLA *inaurita*, Sandb. Dav. Bud. Salt. Mon. (vol. iv), p. 341, pl. xxxviii, fig. 35							×	
— ? *ovalis*, Dav. Bud. Salt. Mon. (vol. iv), p 344, pl. xxxviii, figs 36, 37							×	
— *Thebaulti*, Rouault. Bud. Salt. Mon. (vol. iv), p. 342, pl. xxxviii, figs. 26—29							×	
— *Valpyana*, Dav. Bud. Salt. Mon. (vol. iv), p. 343, pl. xxxviii, figs. 33, 34							×	
— *Vicaryi*, Dav. Bud. Salt. Mon. (vol. iv), p. 343, pl. xxxviii, figs. 30, 31							×	
— *Winwoodiana*, Dav. Bud. Salt. Mon. (vol. iv), p. 340, pl. xxxviii, fig. 19							×	

INDEX

TO THE

GENERA AND SPECIES OF BRITISH FOSSIL BRACHIOPODA

FIGURED AND DESCRIBED IN VOLUMES I, II, III, IV, AND V.

The Abbreviations **TERT.**, **CRET.**, *&c., refer to the Formation in which each Species is found.*

ACROTHELE *granulata*, Linnarsson? Sil. Sup., vol. v, p. xvi, pl. xvi, figs. 29, 30. **SIL.**

ACROTRETA *? costata*, Dav. Sil. Sup., vol. v, p. 213, pl. xv, fig. 24. **SIL.**

— *Nicholsoni*, Dav. Sil. Mon., vol. iii, p. 343, pl. xlix, figs. 36—40. Sil. Sup., vol. v, p. 213, pl. xvi, figs. 21—23. **SIL.**

ARGIOPE *megatrema*, Sow. Cret. Mon., vol. i, p. 101, pl. xii, figs. 31, 32, 34—36 ? and Cret. Sup., vol. iv, p. 23. **CRET.**

— *? oolitica*, Dav. Ool. Sup., vol. iv, p. 111, pl. xi, fig. 16. **JUR.**

ATHYRIS *ambigua*, Sow. Carb. Mon., vol. ii, p. 77, pl. xv, figs. 16—22; and pl. xvii, figs. 11—14, Carb. Sup., vol. iv, p. 283, pl. xxxiv, figs. 10, 11. **CARB.**

— *? Bartoniensis*, Dav. Dev. Mon., vol. iii, p. 19, pl. iii, fig. 23. **DEV.**

— *Budleighensis*, Dav. Bud.-Salt. Mon., vol. iv, p. 338, pl. xxxviii, fig. 6. **DEV.**

— *Carringtoniana*, Dav. Carb. Mon., vol. ii, p. 217, pl. lii, figs. 18—20. **CARB.**

— *compressa*, Sow.; see GLASSIA *compressa*.

— *concentrica*, v. Buch. Dev. Mon., vol. iii, p. 14, pl. iii, figs. 11—15 and 24; Dev. Sup., vol. v, p. 25, pl. i, figs. 23, 24; pl. ii, fig. 10. **DEV.**

— *? erratica*, Dav. Bud.-Salt. Mon., vol. iv, p. 338, pl. xxxviii, fig. 4. **DEV.**

— *expansa*, Phillips. Carb. Mon., vol. ii, p. 82, pl. xvi, figs. 14, 16, 18; pl. xvii, figs. 1—5. **CARB.**

— *Glassii*, Dav. Dev. Sup., vol. v, p. 24, pl. i, figs. 21, 22. **DEV.**

— *globularis*, Phil. Carb. Mon., vol. ii, p. 86, pl. xvii, figs. 15—18. **CARB.**

— *incerta*, Dav. Bud.-Salt. Mon., vol. iv, p. 338, pl. xxxviii, fig. 5. **DEV.**

— *? lævisculla*, Sow. Sil. Mon., vol. iii, pl. x, figs. 28—32. Sil. Sup., vol. v, p. 101, pl. iv, figs. 24—26. **SIL.**

— *lamellosa*, L'Eveillé. Carb. Mon., vol. ii, p. 79, pl. xvi, fig. 1; and pl. xvii, fig. 6; p. 217, pl. li, fig. 14. Carb. Sup., vol. iv, p. 217, pl. xxxii, fig. 19. **CARB.**

— *? Newtoniensis*, Dav. Dev. Mon., vol. iii, p. 19, pl. iii, fig. 22. **DEV.**

— *obovata*, Sow.; see GLASSIA *obovata*.

— *pectinifera*, Sow. Permian Mon., vol. ii, p. 21, pl. i, figs. 50—56; pl. ii, figs. 1—5. **PERM.**

— *? phalæna*, Phil. Dev. Mon., vol. iii, p. 18, pl. iii, figs. 19—21. **DEV.**

Athyris *pisum*, Dav. Carb. Sup., vol. iv, p. 282, pl. xxx, fig. 15. **CARB.**

— *planosulcata*, Phillips. Carb. Mon., vol. ii, p. 80, pl. xvi, figs. 2—13, 15, p. 217; pl. li, figs. 11—13. Carb. Sup., vol. iv, pl. xxxii, fig. 20. Sil. Sup., vol. v, p. 98, pl. iv, figs. 14—19. **CARB.**

— *Royssii*, L'Eveillé. Carb. Mon., vol. ii, p. 84, pl. xviii, figs. 1—11. Carb. Sup., vol. iv, pl. xxxii, fig. 18; pl. xxxiv, figs. 7 and 12. **CARB.**

— *rugata*, Dav. Dev. Sup., vol. v, p. 26, pl. i, fig. 25. **DEV.**

— *squamigera*, de Kon.? Carb. Mon., vol. ii, p. 83, pl. xviii, figs. 12, 13. **CARB.**

— *subtilita*, Hall. Carb. Mon., vol. ii, p. 18, pl. i, figs. 21, 22; pl. xvii, figs. 8—10, and p. 217. **CARB.**

Atrypa *aspera*; see Atrypa *reticularis*, var. *aspera*.

— *asperula*, Dav. Sil. Mon., vol. iii, pl. xiv, fig. 22. Sil. Sup., vol. v, p. 112, pl. iv, fig. 8. **SIL.**

— *Barrandii*, Dav. (under Retzia). Sil. Mon., vol. iii, p. 128, pl. xiii, figs. 10—13. Sil. Sup., vol. v, p. 114, pl. vii, fig. 7. **SIL.**

— *depressa*, Sow.; see Rhynchonella *Glassiana*.

— *desquamata*, Sow. Dev. Mon., vol. iii, p. 58, pl. x, figs. 9—13; pl. xi, figs. 1—9. Dev. Sup., vol. v, p. 39, pl. i, fig. 15. **DEV.**

— *flabellata*, Gold. Dev. Mon., vol. iii, p. 59, pl. xi, figs. 11, 12. **DEV.**

— ? *Grayii*, Dav.; see Streptis *Grayii*.

— *hemisphærica*, Sow.; see Leptocœlia *hemisphærica*.

— *imbricata*, Sow. Sil. Mon., vol. iii, p. 135, pl. xv, figs. 3—8. Sil. Sup., vol. v, p. 115, pl. iv, fig. 7. **SIL.**

— *latilinguis*, Dav. Dev. Sup., vol. v, p. 41, pl. ii, fig. 9. **DEV.**

— *lens*, Dav. Dev. Mon., vol. iii, p. 51, pl. x, fig. 1. **DEV.**

— *lepida*, Dav.; see Bifida *lepida*.

— *marginalis*, Dalman. Sil. Mon., vol. iii, p. 133, pl. xv, figs. 1, 2. Sil. Sup., vol. v, p. 113, pl. vii, fig. 8. **SIL.**

— ? *Mawii*, Dav. Sil. Sup., vol. v, p. 116, pl. iv, fig. 6. **SIL.**

— (Rhynchonella?) *nana*, M'Coy. Carb. Mon., vol. ii, p. 110, pl. xxv, fig. 15. **CARB.**

— *reticularis*, Linné. Dev. Mon., vol. iii, p. 53, pl. x, figs. 3, 4. Dev. Sup., vol. v, p. 39, pl. i, fig. 16. Sil. Mon., vol. iii, p. 129, pl. xiv, figs. 1—21. Sil. Sup., vol. v, p. 109, pl. vi, figs. 14, 15; and pl. vii, figs. 1—6. **DEV.—SIL.**

— — var. *aspera*, Schl. Dev. Mon., vol. iii, p. 57, pl. x, figs. 5—8. Dev. Sup., vol. v, p. 40. **DEV.**

— ? *Scotica*, M'Coy. Sil. Mon., vol. iii, p. 140, pl. xiii, fig. 31. **SIL.**

— ? *trigonella*, Dav. Dev. Sup., vol. v, p. 40, pl. i, fig. 19. **DEV.**

Aulacorhynchus *Davidsoni*, Dittmar (under the name of Chonetes *concentrica*, de Kon.). Carb. Mon., vol. ii, p. 278, pl. lv, fig. 13. Appendix to Sup., vol. v, p. 283, pl. xx, fig. 22. **CARB.**

Bifida *lepida*, Goldf. (Atrypa, Dav.). Dev. Mon., vol. iii, p. 52, pl. x, fig. 2. Dev. Sup., vol. v, p. 27, pl. ii, fig. 13. **DEV.**

— *Huntii*, Dav. Dev. Sup., vol. v, p. 28, pl. i, figs. 17, 18. **DEV.**

Camarophoria *crumena*,[1] Martin. Carb. Mon., vol. ii, p. 113, pl. xxv, figs. 3—9; p. 267, pl. liv, figs. 16—18. **CARB.**

[1] Camarophoria *crumena* and *C. Schlotheimi* are probably synonymous.

CAMAROPHORIA *globulina*,[1] Phillips. Perm. Mon. vol. ii, p. 27, pl. ii, figs. 28—31. Carb. Mon., vol. ii, p. 115, pl. xxiv, figs. 9—22. **PERM.—DEV.**

— *Humbletoniensis*, Howse = C. *multiplicata*, King. Perm. Mon., vol. ii, p. 27, pl. ii, figs. 9—15. **PERM.**

— *isorhyncha*, M'Coy. Carb. Mon., vol. ii, p. 117, pl. xxv, figs. 1, 2. **CARB.**

— *Kingii*, Dav. Carb. Sup., vol. iv, p. 287, pl. xxxiii, figs. 12, 13. **CARB.**

— ? *laticliva*, M'Coy. Carb. Mon., vol. ii, p. 116, pl. xxv, figs. 11, 12. **CARB.**

— *multiplicata*, King; see CAMAROPHORIA *Humbletonensis*.

— *rhomboidea*,[1] Phil. Carb. Mon., vol. ii, p. 268, pl. liv, figs. 20—22. Dev. Mon., vol. iii, p. 70, pl. xiv, figs. 19—22. Dev. Sup., vol. v, p. 48. **CARB.—DEV.**

— *Schlotheimi*,[2] v. Buch. Perm. Mon., vol. ii, p. 25, pl. ii, figs. 16—27. **PERM.—CARB.**

CENTRONELLA *virgo*, Phillips sp. Dev. Sup., vol. v, p. 14, pl. i, figs. 7—9. **DEV.**

CHONETES *Buchiana*, de Kon. Carb. Mon., vol. ii, p. 184, pl. xlvii, figs. 1—7 and 28; and pl. lv, fig. 12; pl. lii, fig. 21. **CARB.**

— *comoides*, Sow. Carb. Mon., vol. ii, pp. 180, 275, 276, pl. xlv, fig. 7 (not 1—6, which belongs to PRODUCTUS *Llangollensis*, Dav.), pl. lv, figs. 6, 7. **CARB.**

— *convoluta*, Phillips. Dev. Mon., vol. iii, pl. xix, fig. 9 (not *C. Hardrensis*). Dev. Sup., vol. v, p. 55. **DEV.**

— *Dalmaniana*, de Kon. Carb. Mon., vol. ii, p. 183, pl. xlvi, fig. 7. **CARB.**

— *Davidsoni*, Schauroth. Perm. Sup., vol. iv, p. 244, pl. xxx, figs. 1, 2. **PERM.**

— *gibberula*, M'Coy. Carb. Mon., vol. ii, p. 188. Carb. Sup., vol. iv, p. 313, pl. xxxiv, figs. 19, 20. **CARB.**

— *Hardrensis*, Phil. Dev. Mon., vol. iii, p. 94, pl. xix, figs. 6—8 (not 9). Dev. Sup., vol. v, p. 54, pl. iii, fig. 24. **DEV.**

— *Laguissiana*, de Kon. (as *C. Hardrensis*, Phil.). Carb. Mon., vol. ii, p. 186, pl. xlvii, figs. 12—16 (17, 18, and 25 ?). Carb. Sup., vol. iv, p. 312, pl. xxxiv, fig. 18. App. to Sup., vol. v, p. 280, pl. xx, figs. 20, 21. **CARB.**

— *lata*, Sow.; see CHONETES *striatella*.

— *lepisma*, Sow. (not of Dalman). Sil. Mon., vol. iii, p. 333, pl. xlix, figs. 13, 14. **SIL.**

— *minima*, Sow. (as L. *Grayii*, Dav.). Sil. Mon., vol. iii, p. 334, pl. xlix, figs. 15—19. **SIL.**

— *minuta*, Goldf. Dev. Mon., vol. iii, p. 96, pl. xix, figs. 10—12. **DEV.**

— *papilionacea*, Phillips. Carb. Mon., vol. ii, p. 182, pl. xlvi, figs. 3, 6. **CARB.**

— *perlata*, M'Coy. Carb. Mon., vol. ii, p. 189. **CARB.**

— ? *Phillipsii*, Dav. Dev. Sup., vol. v, p. 54, pl. iii, fig. 23. **DEV.**

— *polita*, M'Coy. Carb. Mon., vol. ii, p. 190, pl. xlvii, figs. 8—11. **CARB.**

— *serrata*, M'Coy. Carb. Mon., vol. ii, p. 191. **CARB.**

— *striatella*, Dalman = *C. lata*, Sow. Sil. Mon., vol. iii, p. 331, pl. xlix, figs. 23—26. **SIL.**

— *sub-minima*, M'Coy. Carb. Mon., vol. ii, p. 188. **CARB.**

— *sulcata*, M'Coy. Carb. Mon., vol. ii, p. 189. **CARB.**

— *tuberculata*, M'Coy. Carb. Mon., vol. ii, p. 191. **CARB.**

— *volva*, M'Coy. Carb. Mon., vol. ii, p. 189. **CARB.**

CISTELLA (ARGIOPE) *Bronnii*, von Hag. Cret. Mon., vol. i, p. 102, pl. iii, figs. 1—13; and pl. xii, figs. 37, 38. Cret. Sup., vol. iv, p. 23. **CRET.**

— (ARGIOPE) *cistellula*, S. Wood. Recent and Tertiary Sup., vol. iv, p. 6, pl. i, fig. 2; and Tertiary Mon., vol. i, p. 10, pl. i, fig. 13. **TERT.—RECENT.**

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[1] CAMAROPHORIA *globulina* and *C. rhomboidea* are probably synonymous.

[2] CAMAROPHORIA *Schlotheimi* and *C. crumena* are probably synonymous.

Crania *antiquior*, Jelly. Ool. Mon., vol. i, p. 11, pl. i, figs. 4—8, and Ool. Sup., vol. iv, p. 89, pl. ix, figs. 36, 37. **JUR.**

— *canalis*, Moore. Ool. Sup., vol. iv, p. 90, pl. ix, figs. 32—35. **JUR.**

— *Cenomaniensis*, d'Orb.? Cret. Mon., vol. i, p. 103, pl. xii, figs. 40, 41 (this is probably the *C. irregularis*, Rœmer, and not d'Orbigny's species). **CRET.**

— *Crofti*, Dav. Sil. Sup., vol. v, p. 215, pl. xvii, figs. 54—56. **SIL.**

— *divaricata*, M'Coy. Sil. Mon., vol. iii, p. 78, pl. viii, figs. 7—12. **SIL.**

— ? *Grayii*, Dav. Sil. Mon., vol. iii, p. 82, pl. viii, figs. 22—24. **SIL.**

— *Griffini*, Dav. Ool. Sup., vol. iv, p. 226, pl. xxix, fig. 23. **JUR.**

— *Gumberti*, E. Desl. Ool. Sup., vol. iv, p. 90, pl. ix, figs. 40, 41. **JUR.**

— *Ignabergensis*, Retzius. Cret. Mon., vol. i, p. 11, pl. i, figs. 8—14, and Cret. Sup., vol. iv, p. 22. **CRET.**

— *irregularis*, Rœmer? Cret. Sup., vol. iv, p. 22. Cret. Mon., vol. i, pl. xii, figs. 40, 41. **CRET.**

— *Kirkbyi*, Dav. Perm. Mon., vol. ii, pp. 49, 270. Carb. Mon., pl. liv, figs. 35—38. **PERM.**

— *liassiana*, Moore. Ool. Sup., vol. iv, p. 91. **JUR.**

— *Moorei*, Dav. Ool. Mon., vol. i, p. 12, figs. 1—9. **JUR.**

— *Parisiensis*, Def. Cret. Mon., vol. i, p. 8, pl. i, figs. 1—7. Cret. Sup., vol. iv, p. 22. **CRET.**

— *quadrata*, M'Coy. Carb. Mon., vol. ii, p. 194, pl. xlviii, figs. 1—13. Carb. Sup., p. 268. **CARB.**

— *Ryckholtiana*, De Kon. Carb. Mon., vol. ii, p. 195, pl. xlviii, figs. 15, 16, 17? Sil. Sup., vol. v, *footnote*, p. 216, pl. xvii, fig. 57. **CARB.**

— *Saundersii*, Moore. Ool. Mon., vol. iv, p. 89, pl. ix, figs. 38, 39. **JUR.**

— *Siluriana*, Dav. Sil. Mon., vol. iii, p. 82, pl. viii, figs. 19, 20. Sil. Sup., vol. v, p. 215, pl. xvii, figs. 49—53. **SIL.**

— *transversa*, Dav. Bud. Salt. Mon., vol. iv, p. 352, pl. xl, figs. 9, 10. **DEV.**

Cyrtia *exporrecta*, Wahl. Sil. Mon., vol. iii, p. 99, pl. ix, figs. 13—24. Sil. Sup., vol. v, p. 137, pl. vi, fig. 13; p. 137, pl. viii, figs. 4, 5. **SIL.**

— ? *Whidbornei*, Dav. Dev. Sup., vol. v, p. 36, pl. ii, figs. 6, 7. **DEV.**

Cyrtina ? *amblygona*, Phillips. Dev. Mon., vol. iii, p. 51, pl. ix, figs. 18—20. **DEV.**

— *carbonaria*, M'Coy. Carb. Mon., vol. ii, p. 71, pl. xv, figs. 5—14. **CARB.**

— *Demarlii*, Bouchard. Dev. Mon. vol. iii, p. 50, pl. ix, figs. 15—17. **DEV.**

— *dorsata*, M'Coy. Carb. Mon., vol. ii, p. 70, pl. xv, figs. 3, 4. **CARB.**

— *heteroclita*, Def. Dev. Mon., vol. iii, p. 48, pl. ix, figs. 1—16. Dev. Sup., vol. v, p. 37, pl. i, figs. 35—37. **DEV.**

— — var. *multiplicata*, Dav. Dev. Mon., vol. iii, pl. ix, p. 49, figs. 11—14. **DEV.**

— *septosa*, Phillips. Carb. Mon., vol. ii, p. 68, pl. xiv, figs. 1—10; pl. xv, figs. 1, 2, p. 227; pl. li, fig. 17; pl. li, fig. 19. **CARB.**

Davidsonia *Verneuilii*, Bouchard. Dev. Mon., vol. iii, p. 74, pl. xi, figs. 13—16; pl. xv, fig. 18. Dev. Sup., vol. v. **DEV.**

Dayia *navicula*, Sow. (as Rhynchonella). Sil. Mon., vol. iii, p. 190, pl. xxii, figs. 20—23. Sil. Sup., vol. v, p. 96, pl. v, figs. 1—4. **SIL.**

Dielasma (Terebratula) *elongata*, Schl. Perm. Mon., vol. ii, p. 8, pl. i, figs. 5—22; and pl. ii, fig. 2. Dev. Mon., vol. iii, p. 8, pl. i, fig. 9. **PERM.—DEV.**

— — var. *genuina*, King. Perm. Mon., vol. ii, p. 9, pl. i, figs. 5—7, 12—14, and 18—22. **PERM.**

— — var. *sufflata*, Schl. Perm. Mon., vol. ii, p. 10, pl. i, figs. 9—11, 15—17, and 21; pl. ii, fig. 2. **PERM.**

DIELASMA (TER.) *hastata*, Sow. Carb. Mon., vol. ii, pp. 11, 213, and 266, pl. i, figs. 1—12. **CARB.**

— — var. *ficus*, M'Coy. Carb. Mon., vol. ii, p. 13, pl. i, figs. 13—16. **CARB. DEV.**

— ? *juvenis*, Sow. Dev. Mon., vol. iii, p. 8, pl. i, figs. 10—15 (see WALDHEIMIA *juvenis*). Dev. Sup., vol. iv, p. 13, pl. i, figs. 1—3. **DEV.**

— ? (TER.) *Newtoniensis*, Dav. Dev. Mon., vol. iii, p. 8, pl. i, figs. 16, 17. Dev. Sup., p. 14, pl. i, fig. 6. **DEV.**

— — *sacculus*, Sow. Carb. Mon., vol. ii, p. 14, pl. i, figs. 23, 24, 27, 29, 30. Carb. Sup., vol. iv, p. 269, pl. xxx, fig. 17. Bud. Salt. Mon., vol. iv, p. 337, pl. xxxviii, figs. 1—3. **CARB.**

— — *vesicularis*, de Kon. Carb. Mon, vol. ii, p. 15, pl. i, figs. 25, 26, 28, 31, 32; pl. ii, figs. 1—8. **CARB.**

DINOBOLUS *Brimonti*, Rouault (under the mistaken name of LINGULA *Hawkei*). Sil. Mon., vol. iii, p. 41, pl. i, figs. 25, 26; and Bud.-Salt. Mon., vol. v, p. 365, pl. xl, figs. 22, 23. **SIL.**

— *Davidsoni*, Salter (as OBOLUS). Sil. Mon., vol. iii, p. 58, pl. iv, figs. 30—39. Sil. Sup., vol. v, p. 212, pl. xvi, fig. 20. **SIL.**

— — var. *transversus*, Salter (as OBOLUS). Sil. Mon., vol. iii, p. 59, pl. v, figs. 1—6. **SIL.**

— — var. *Woodwardii*, Salter (as OBOLUS). Sil. Mon., vol. iii, p. 60, pl. v, figs. 7, 8. **SIL.**

— ? *Hicksii*. Sil. Sup., vol. v, p. 212, pl. xvi, fig. 19. **SIL.**

DISCINA *annulosa*, Dav. Ool. Sup., vol. iv, p. 87, pl. x, fig. 15. **JUR.**

— *Babeana*, d'Orb. (as D. *Townshendi*, Forbes). Ool. Mon., vol. i, p. 7, pl. i, fig. 2; and Triassic Sup., vol. iv, p. 87, pl. x, figs. 21—24. **JUR.—TRIAS.**

— *Caerfaiensis*, Hicks. Sil. Sup., vol. v, p. 209, pl. xvii, figs. 37, 38. **SIL.**

— *Craigii*, Dav. Carb. Sup., vol. iv, p. 267, pl. xxx, fig. 14. **CARB.**

— *crassa*, Hall. Sil. Mon., vol. iii, p. 69, pl. vi, figs. 6, 7. **SIL.**

— *Davidsoni*, Moore. Ool. Sup., vol. iv, p. 84, pl. x, fig. 11. **JUR.**

— *Davreuxiana*, de Kon. Carb. Mon., vol. ii, p. 198, pl. xlviii, figs. 26. **CARB.**

— *Dundriensis*, Moore. Ool. Sup., vol. iv, p. 84, pl. x, fig. 13. **JUR.**

— ? *Edgelli*, Dav. Bud.-Salt. Mon., vol. iv, p. 353. **DEV.**

— *elevata*, Blake. Ool. Sup., vol. iv, p. 81, pl. xi, fig. 31. **JUR.**

— *Etheridgei*, Dav. Ool. Sup., vol. iv, p. 86, pl. x, fig. 20. **JUR.**

— *fallens*, S. Wood (as D. *lamellosa*). Tertiary Mon., vol. i, p. 7, pl. i, fig. 9; and Tertiary Sup., vol. iv, p. 13, pl. i, fig. 9. **TERT.**

— *Gunnii*, Dav. Appendix to Sup., vol. v, p. 279, pl. xx, fig. 19. **JUR.**

— *Holdeni*, Tate. Ool. Sup., vol. iv, p. 85, pl. x, fig. 12, and pl. xi, fig. 32. **JUR.**

— *Humphresiana*, Sow. Ool. Mon., vol. i, p. 10, pl. i, fig. 3; and Ool. Sup., vol. iv, p. 81, pl. xiii, figs. 17—19. **JUR.**

— *incerta*, Dav. Bud.-Salt. Mon., vol. iv, p. 353, pl. xl, fig. 145; Sil. Mon., vol. iii, p. 67, pl. vii, fig. 13. **DEV.**

— *Koninckii*, Geinitz. Permian Mon., vol. ii, p. 50, pl. iv, figs. 27—29. Permian Sup., vol. iv, pl. xxx, fig. 4. **PERM.**

— *latissima*, Dav. Ool. Sup., vol. iv, p. 80, pl. x, figs. 16—19; and pl. xi, fig. 30. **JUR.**

— ? *Moorei*, Dav. Ool. Sup. vol. iv, p. 85, pl. x, fig. 14. **JUR.**

— *nitida*, Phillips. Carb. Mon., vol. ii, pp. 197, 268, pl. xlviii, figs. 18—25, pl. liv, fig. 26; and Carb. Sup., vol. iv, pl. xxx, figs. 12, 13. Dev. Mon., vol. iii, p. 104, pl. xx, figs. 9, 10. **CARB.—DEV.**

Discina *oblongata*, Portlock. Sil. Mon., vol. iii, p. 66, pl. vii, figs. 1—9. Sil. Sup., vol. v, p. 209, pl. xvii, figs. 43—46. **SIL.**

— *orbicularis*, Moore. Ool. Sup. vol. iv, p. 83, pl. x, figs. 9, 10. **JUR.**

— *perrugata*, M'Coy. Sil. Mon., vol. iii, p. 65, pl. v, fig. 19—24. Sil. Sup., vol. v, p. 210, pl. xvii, fig. 47. **SIL.**

— *pileolus*, Hicks. Sil. Mon., vol. iii, p. 344, pl. xlix, figs. 41, 42. **SIL.**

— *Portlockii*, Geinitz. Sil. Sup., vol. v, p. 210, pl. xvii, figs. 39, 40. **SIL.**

— *reflexa*, Sow. Ool. Mon., vol. i, p. 10, pl. x, fig. 8; and Ool. Sup., vol. iv, p. 82, pl. x, figs. 1—6. **JUR.**

— *rugata*, Sow. Sil. Mon., vol. iii, p. 63, pl. v, figs. 9—18. **SIL.**

— *striata*, Sow. Sil. Mon., vol. iii, p. 67, pl. vi, figs. 1—4. **SIL.**

— *Townshendi*, Forbes; see Discina *Babeana*.

— *Verneuili*, Dav. Sil. Mon., vol. iii, p. 68, pl. vi, fig. 5. **SIL.**

— *Vicaryi*, Dav. Bud.-Salt. Mon., vol. iv, p. 353, pl. xl, figs. 11—13. **DEV.**

Eichwaldia *Capewelli*, Dav. Sil. Mon., vol. iii, p. 193, pl. xxv, figs. 12—15. Sil. Sup., vol. v, p. 140, pl. viii, figs. 15, 16. General Summary, p. 355. **SIL.**

Glassia *compressa*, Sow. (as Athyris). Sil. Mon., vol. iii, p. 122, pl. xii, figs. 16—18. **SIL.**

— *elongata*, Dav. Sil. Sup., vol. v, p. 119, pl. vii, figs. 9, 10. **SIL.**

— *obovata*, Sow. (as Athyris). Sil. Mon., vol. iii, p. 121, pl. xii, fig. 19; pl. xiii, fig. 5. Sil. Sup., vol. v, p. 116, pl. vii, figs. 11—20. **SIL.**

— *Whidbornei*, Dav. Dev. Sup., vol. v, p. 38, pl. i, figs. 10—14. **DEV.**

Kayseria *lens*, Phil. (Atrypa). Dev. Mon., vol. iii, p. 51, pl. x, fig. 1. Dev. Sup., vol. v, p. 21, pl. ii, figs. 11, 12. **DEV.**

Kingena *lima*, d'Orb. Cret. Mon., vol. i, p. 42, pl. iv, figs. 15—28; and pl. v, figs. 1—4. Cret. Sup., vol. iv, p. 28. **CRET.**

— ? *rhomboidalis*, W. Keeping. Appendix to Sup., vol. v, p. 246, pl. xviii, fig. 10. **CRET.**

Konchinella *Bouchardii* (under the name of Leptæna). Ool. Mon., vol. i, p. 19, pl. i, fig. 22. Appendix to Sup., vol. v, p. 278. **JUR.**

— *liasiana*, Bouchard (under the name of Leptæna). Ool. Mon., vol. i, p. 18, pl. i, fig. 21. Ool. Sup., vol. iv, p. 93. Appendix to Sup., vol. v, p. 278, pl. xx, fig. 18. **JUR.**

— *rostrata*, E. Desl. Ool. Sup., vol. iv, p. 92, pl. x, fig. 30. Appendix to Sup., vol. v, p. 278. **JUR.**

Kutorgina *cingulata*, Billings. Sil. Mon., vol. iii, p. 342, pl. l, fig. 25. Sil. Sup., vol. v, p. 212. **SIL.**

Leptæna *Bouchardii*, Dav.; see Konichella *Bourchardii*.

— *cornuta*, Dav.; see Leptæna *segmentum*, var. *cornuta*.

— ? *Davidsoni*, E. Desl. Ool. Sup., vol. iv, p. 91, pl. x, figs. 37—30. **JUR.**

— *Etheridgei*, Dav. Sil. Sup., vol. v, p. 170, pl. xii, figs. 11, 12. **SIL.**

— ? *granulosa*, Dav. Ool. Mon., vol. i, p. 18, pl. i, fig. 20 (see Terebratulina? *Deslongchampsii*, Dav.). Ool. Sup., vol. iv, p. 94. **JUR.**

— *Grayæ*, Dav. Sil. Sup., vol. v, p. 171, pl. xii, figs. 23—25. **SIL.**

— ? *interstrialis*, Phil. Dev. Mon., vol. iii, p. 85, pl. xviii, figs. 15—18. **DEV.**

— ? *irregularis*, Roemer. Appendix to Sup., vol. v, p. 285, pl. xx, fig. 23. **DEV.**

— *lævigata*, Sow. Sil. Mon., vol. iii, p. 328, pl. xlix, figs. 1—12. **SIL.**

— ? *laticosta*, Conrad. Dev. Mon., vol. iii, p. 87, pl. xvii, figs. 1—3. **DEV.**

LEPTÆNA *liasiana*, Bouchard; see KONINCHELLA *liasiana*.

— *Llandeilolensis*, Dav. Sil. Sup., vol. v, p. 171, pl. xii, figs. 26—29. **SIL.**

— ? *Looiensis*, Dav. Dev. Mon., vol. iii, p. 84, pl. xviii, figs. 13, 14. Dev. Sup., vol. v, p. 53. **DEV.**

— ? *nobilis*, M'Coy. Dev. Mon., vol. iii, p. 86, pl. xviii, figs. 19—21. Dev. Sup., vol. v, p. 53. **DEV.**

— ? *Moorei*, Dav. Ool. Mon., vol. i, p. 17, pl. i, fig. 18. **JUR.**

— ? *Pearcei*, Dav. Ool. Mon., vol. i, p. 17, pl. i, fig. 19 (not a Brachiopod, perhaps referable to the genus *Monotis*). Ool. Sup., vol. iv, p. 93. **JUR.**

— *quinquecostata*, M'Coy. Sil. Mon., vol. iii, p. 322, pl. xlviii, figs. 23—27. Sil. Sup., vol. v, p. 169, pl. xii, fig. 13. **SIL.**

— *rhombica*, M'Coy; see LEPTÆNA *sericea*, var. *rhombica*.

— *rostrata*, E. Desl.; see KONINCHELLA *rostrata*.

— *scissa*, Salter; see LEPTÆNA *sericea*, var *scissa*.

— *segmentum*, Angelin. Sil. Mon., vol. iii, p. 321, pl. xlviii, figs. 28—30. **SIL.**

— — var. *cornuta*, Dav. Sil. Sup., vol. v, p. 166, pl. xii, figs. 1—3. **SIL.**

— *sericea*, Sow. Sil. Mon., vol. iii, p. 323, pl. xlviii, figs. 10—19. Sil. Sup., vol. v, p. 169, pl. xii, figs. 8—10. **SIL.**

— — var. *rhombica*, M'Coy. Sil. Mon., vol. iii, p. 325, pl. xlviii, figs. 20—22. Sil. Sup., vol. v, p. 169, pl. xii, figs. 4—7. **SIL.**

— — var. *scissa*, Salter. Sil. Mon., vol. iii, p. 325, pl. xlvii, figs. 21—25. Sil. Sup., vol. v, p. 170, pl. xii, fig. 22. **SIL.**

— *tenuicincta*, M'Coy. Sil. Mon., vol. iii, p. 326, pl. xlvii, figs. 7—18. Sil. Sup., vol. v, p. 168; and pl. xii, figs. 17—21. **SIL.**

— *tenuissime-striata*, M'Coy. Sil. Mon., vol. iii, p. 330, pl. xlix, figs. 20—22. **SIL.**

— *transversalis*, Wahl. Sil. Mon., vol. iii, p. 318, pl. xlviii, figs. 1—9. **SIL.**

— *Youngiana*, Dav. Sil. Mon., vol. iii, p. 320, pl. xlvii, figs. 19, 20. Sil. Sup., vol. v, p. 168, pl. xii, figs. 14—16. **SIL.**

LEPTOCŒLIA *hemisphærica*, Sow. (ATRYPA). Sil. Mon., vol. iii, p. 136, pl. xiii, figs. 23—30 (belongs in all probability to the sub-family *Centronellinæ*). **SIL.**

LINGULA *attenuata*, Sow. Sil. Mon., vol. iii, p. 44, pl. iii, figs. 18—27. Sil. Sup., vol. v, p. 206, pl. xvii, figs. 13—19. **SIL.**

— *Beanii*, Phillips. Ool. Mon., vol. i, p. 8, in part *not the figures*. Ool. Sup., vol. iv, p. 78, pl. ix, figs. 10—14? **JUR.**

— *Bechei*, Salter. Sil. Mon., vol. iii, p. 44, pl. i, figs. 12, 13. **SIL.**

— *brevis*, Portlock. Sil. Mon., vol. iii, p. 50, pl. iii, figs. 34—39. Sil. Sup., vol. v, p. 207, pl. xvii, figs. 26—30. **SIL.**

— *Brodieana*, Dav. As L. *Brodiei*, Dav., in Sil. Sup., vol. v, p. 204, pl. xvii, fig. 4. **SIL.**

— *Brodiei*, Dav. Ool. Sup., vol. iv, p. 225, pl. ix, fig. 31. **JUR.**

— *Canadensis*, Billings. Sil. Sup., vol. v, p. 202, pl. xvii, fig. 1. **SIL.**

— *cornea*, Sow. Sil. Mon., vol. iii, p. 46, pl. ii, figs. 28—35. **SIL.**

— *Craneæ*, Dav. Ool. Mon. Sup., vol. iv, p. 75, pl. ix, figs. 21, 22? **JUR.**

— *Credneri*, Geinitz. Permian Mon., vol. ii, p. 51, pl. iv, figs. 30, 31; and Carb. Mon., vol. ii, p. 209, pl. xlviii, figs. 38—40. **PERM.—CARB.**

— *crumena*, Phillips. Sil. Mon., vol. iii, p. 40, pl. ii, figs. 1—6. **SIL.**

— *curta*, Conrad? Sil. Mon., vol. iii, p. 52, pl. iii, fig. 33. **SIL.**

— *Dumortierei*, Nyst. Tert. Mon., vol. i, p. 5, pl. i, figs. 10, 11. Tert. Sup., vol. iv, p. 13, pl. ii, fig. 9. **TERT.**

Lingula *Davidsoni*, Oppel. Ool. Sup., vol. iv, p. 76, pl. ix, figs. 23, 23ª. **JUR.**
— *granulata*, Phillips. Sil. Mon., vol. iii, p. 36, pl. ii, figs. 15—18. Sil. Sup., p. 207, pl. xvii, figs. 20, 21. **SIL.**
— *Hawkei*, Rouault (under the mistaken name of L. *Rouaulti*, Salter). Sil. Mon., vol. iii, p. 40, pl. 1, figs. 14—20. Sil. Sup., vol. iv, p. 363, pl. xl, fig. 21. **SIL.**
— *longuissima*, Pander? Sil. Mon., vol. iii, p. 51, pl. iii, figs. 28—30. **SIL.**
— *lata*, Sow. Sil. Mon., vol. iii, p. 49, pl. iii, figs. 40—44. **SIL.**
— *latior*, M'Coy. Carb. Mon., vol. ii, p. 210, pl. xlviii, fig. 37. **CARB.**
— *Lesueuri*, Rouault. Sil. Mon., vol. iii, p. 42, pl. i, figs. 1—11. Sil. Sup., vol. iv, Bud. Salt. Mon., p. 361, pl. xl, figs. 16–20 Sil. Sup., vol. v, p. 204, pl. xvii, fig. 12. **SIL.**
— *Lewisii*, Sow. Sil. Mon., vol. iii, p. 35, pl. iii, figs. 1—6. **SIL.**
— *longo-viciensis*, Terquem. Ool. Sup., vol. iv, p. 75, pl. ix, figs. 24—26. **JUR.**
— *metensis*, Terquem. Ool. Sup., vol. iv, p. 77, pl. ix, figs. 27—30. **JUR.**
— *minima*, Sow. Sil. Mon., vol. iii, p. 48, pl. ii, figs. 36—44. **SIL.**
— *mola*, Salter; see Lingula *squamiformis*.
— *Morierei*, Tromelin. Sil. Mon., vol. iii, pl. i, fig. 31; and vol. iv, Bud.-Salt. Mon., p. 354, pl. xl, figs. 25, 26. **SIL.**
— *mytiloides*, Sow. Carb. Mon., vol. ii, pp. 207, 268, pl. xlviii, figs. 29—36; pl. liv, figs. 28—31. **CARB.**
— *obtusa*, Hall? Sil. Mon., vol. iii, p. 52, pl. iii, fig. 31. **SIL.**
— *ovalis*, Sow. Ool. Mon., vol. i, p. 98, pl. xviii, fig. 14. Ool. Sup., vol. iv, p. 74, pl. ix, figs. 1—9; pl. x, fig. 16ᵇ; pl. xi, fig. 29; pl. xxix, fig. 22? **JUR.**
— *parallela*, Phillips. Sil. Mon., vol. iii, p. 39, pl. ii, figs. 24—27. **SIL.**
— *Philipi*, Dav. Sil. Sup., vol. v, p. 206, pl. xvii, fig. 5. **SIL.**
— *pygmæa*, Salter. Sil. Mon., vol. iii, p. 53, pl. ii, fig. 8. **SIL.**
— *quadrata*, d'Eichwald. Sil. Sup., vol. v. p. 203, pl. xvii, figs. 2, 3. **SIL.**
— *Ramsayi*, Salter. Sil. Mon., vol. iii, p. 49, pl. iii, figs. 49—52. Sil. Sup., vol. v, p. 206, pl. xvii, figs. 6—11. **SIL.**
— *Rouaulti*, Salter; see Lingula *Hawkei*.
— *sacculus*, Dewalque. Ool. Mon., vol. i, part, pl. i, fig. 1. Ool. Sup., vol. iv, p. 79, pl. ix, figs. 15—20; pl. x, fig. 25. **JUR.**
— ? *Salteri*, Dav. Sil. Mon., vol. iii, p. 53, pl. i, figs. 27—29; Bud.-Salt. Mon., vol. iv, p. 364, pl. xl, fig. 24. **SIL.**
— *Scotica*, Dav. Carb. Mon., vol. ii, p. 207, pl. xlviii, figs. 27, 28; and Carb. Sup., vol. iv, p. 265, pl. xxx, figs. 5—8. **CARB.**
— *squamiformis*, Phillips. Carb. Mon., vol. ii, p. 205, pl. xlix, figs. 1—10. Carb. Sup., vol. iv, p. 266, pl. xlix, figs. 1—10. Dev. Sup., vol. v, p. 55. **CARB.**
= *L. mola*, Salter. Dev. Mon., vol. iii, p. 105, pl. xx, fig. 13. **DEV.**
— *squamosa*, Holl. Sil. Mon., vol. iii, p. 41, pl. ii, fig. 7. **SIL.**
— *striata*, Sow. Sil. Mon., vol. iii, p. 45, pl. iii, figs. 45—48. **SIL.**
— *subovalis*, Dav. Cret. Mon., vol. i, p. 7, pl. i, figs. 29, 30. Cret. Sup., vol. iv, p. 21. **CRET.**
— *Symondsii*, Salter. Sil. Mon., vol. iii, p. 45, pl. iii, figs. 7—11. Sil. Sup., vol. v, pl. xvii, figs. 23, 24. **SIL.**
— *tenuigranulata*, M'Coy. Sil. Mon., vol. iii, p. 37, pl. ii, figs. 9—14. **SIL.**
— *tenuis*, Sow. Tert. Mon., vol. i, p. 6, pl. i, fig. 12; and Appendix to vol. i, p. 10, pl. A, figs. 3—5. Tert. Sup., vol. iv, p. 12, pl. ii, figs. 6—8. **TERT.**
— *Thompsoni*, Dav. Carb. Sup., vol. iv, p. 266, pl. xxx, fig. 10. **CARB.**
— *truncata*, Sow. Cret. Mon., vol. i, p. 6, pl. i, figs. 27, 28, and 31. Cret. Sup., vol. iv, p. 21. **CRET.**

LINGULELLA *Davisii*, M'Coy. Sil. Mon., vol. iii, p. 56, pl. iv, figs. 1—16. **SIL.**
— *ferruginea*, Salter. Sil. Mon., vol. iii, p. 336, pl. xlix, figs. 32—35. Sil. Sup., vol. v, pl. xvii, fig. 35. **SIL.**
— *lepis*, Salter. Sil. Mon., vol. iii, p. 54, pl. iii, figs. 54—58. **SIL.**
— *Nicholsoni*, Callaway. Sil. Sup., vol. v, p. 208, pl. xvii, figs. 31, 32. **SIL.**
— ? *petalon*, Hicks. Sil. Mon., vol. iii, p. 337, pl. xlix, fig. 30. **SIL.**
— *primæva*, Hicks. Sil. Sup , vol. v, p. 208, pl. xvii, figs. 33, 34. **SIL.**

MAGAS ? *Geinitzii*, Schloenbach. Cret. Sup., vol. iv, p. 24. **CRET.**
— *pumilus*, Sow. Cret. Mon., vol. i, p. 19, pl. ii, figs. 1—12 and 33. **CRET.**
MARTINIA ? *Carlukensis*, Dav. ; see SPIRIFERA *Carlukensis*.
— *glabra*, Martin ; see SPIRIFERA *glabra*.
— *rhomboidalis*, M'Coy ; see SPIRIFERA *rhomboidalis*.
— *Urii*, Fleming ; see SPIRIFERA *Urii*.
MEGANTHYRIS ? *Vicaryi*, Dav. Dev. Mon., vol. iii, pl. xx, fig. 15. Dev. Sup., vol. v, p. 20, pl. iii, fig 1. **DEV.**
MERISTA ? *Circe*, Barrande? Sil. Mon., vol. iii, p. 116, pl. x, figs. 33—35. Sil. Sup., vol. v, p. 105. **SIL.**
— ? *cymbula*, Dav. Sil. Mon., vol. iii, p. 204, pl. xxii, figs. 28, 29. Sil. Sup., vol. v, p. 138, pl. viii, figs. 6—9. **SIL.**
— *plebeia*, Sow. (=*scalprum*, Roemer). Dev. Mon , vol. iii, p. 20, pl. iii, figs. 2—10 ; and Dev. Sup., vol. v, p. 20, pl. i, figs. 26—29. **DEV.**
MERISTELLA ? *angustifrons*, M'Coy. Sil. Mon., vol. iii, p. 111, pl. x, figs. 21—27. Sil. Sup., vol. v, pl. viii, fig. 1. **SIL.**
— ? *crassa*, Sow. Sil. Mon., vol. iii, p. 117, pl. viii, figs. 1—3. **SIL.**
— ? *furcata*, Sow. Sil. Mon., vol. iii, p. 119, pl. xiii, figs. 7—9. **SIL.**
— ? *Maclareni*, Haswell. Sil. Mon., vol. iii, p. 116, pl. xii, fig. 20. **SIL.**
— ? *sub-undata*, M'Coy. Sil. Mon., vol. iii, p. 120, pl. xiii, fig. 4. Sil. Sup., vol. v, p. 133, pl. vii, figs. 10, 11. **SIL.**
MERISTINA *didyma*, Dalman. Sil. Mon., vol. iii, p. 112, pl. xii, figs. 1—10 ; and Sil. Sup. vol. v, p. 94, pl. iv, figs. 20—23. **SIL.**
— = *nitida*, Hall. Sil. Mon., vol. iii, p. 114, pl. x, figs. 28—32. **SIL.**

NUCLEOSPIRA *pisum*, Sow. Sil. Mon., vol. iii, p. 106, pl. x, figs.16—20. Sil. Sup., vol. v, p. 91, pl. iv, figs. 15—18. **SIL.**
— *Vicaryi*, Dav. Bud.-Salt. Mon., vol. iv, p. 355, pl. xl, figs. 29—31. **SIL.**

OBOLELLA *Belti*, Dav. Sil. Mon., vol. iii, p. 340, pl. l, fig. 15. **SIL.**
— *maculata*, Hicks. Sil. Mon., vol. iii, p. 341, pl. l, figs. 18—21. **SIL.**
— *Sabrinæ*, Callaway. Sil. Sup., vol. v, p. 211, pl. xvi, figs. 27, 28. **SIL.**
— *sagittalis*, Salter. Sil. Mon., vol. iii, p. 339, pl. l, figs. 1—14 ; and Sil. Sup., vol. v, p. 211, pl. xvi, figs. 25, 26. **SIL.**
OBOLUS ? *Phillipsii*, Holl. Sil. Mon., vol. iii, p. 62, pl. iv, figs. 17—19. **SIL.**
— ? *plicatus*, Hicks ; see OBOLUS ? *plumbeus* var. *plicatus*.
— ? *plumbeus*, Salter. Sil. Mon. vol. iii, pp. 61, 341, pl. iv, figs. 20—27 ; pl. l, figs. 23, 24. **SIL.**
— — ? var. *plicatus*, Hicks. Sil. Mon., vol. iii, p. 342, pl. l, fig. 22. **SIL.**
— ? *Salteri*, Holl. Sil. Mon., vol. iii, p. 61, pl. iv, figs. 28, 29. **SIL.**
ORBICULOIDEA *Forbesi*, Dav. Sil. Mon., vol. iii, p. 73, pl.vii, figs. 14—18. **SIL.**

Orthis *Actoniæ*, Sow. Sil. Mon., vol. iii, p. 252, pl. xxxvi, figs. 5—17. Sil. Sup., vol. v, p. 190, pl. xi, fig. 12. **SIL.**
— *æquivalvis*, Dav. Sil. Mon., vol. iii, p. 263, pl. xxx, figs. 9, 10. **SIL.**
— *alata*, Sow. Sil. Mon , vol. iii, p. 232, pl. xxxiii, figs. 17—22. **SIL.**
— *alternata*, Sow. Sil. Mon., vol. iii, p. 264, pl. xxxi, figs. 1—8. Sil. Sup., vol. v, p. 187, pl. xiv, figs. 1—6. **SIL.**
— ? *antiquata*, Phil. Carb. Mon., vol. ii, p. 135, pl. xxviii, fig. 15; and p. 229. **CARB.**
— *arcuata*, Phil. Dev. Mon., vol. iii, p. 93, pl. xvii, figs. 13, 14. **DEV.**
— *Bailyana*, Dav. Sil. Mon., vol. iii, p. 223, pl. xxix, figs. 19, 20. **SIL.**
— *Balcletchiensis*, Dav. Sil. Mon., vol. iii, pl. xxvi, fig. 23. Sil. Sup., vol. v, p. 176, pl. xiii, figs. 12—14. **SIL.**
— *basalis*, Dalman. Sil. Mon., vol. iii, p. 217, pl. xxvii, figs. 10, 11. **SIL.**
— *Berthosi*, var. *erratica*. Sil. Mon., vol. iii, p. 233, pl. xxxii, figs. 21—28. Bud.-Salt. Mon., vol. iv, p. 356, pl. xli, figs. 1—9. **SIL.**
— — var. *Cornubieenis*, Tromelin. Bud.-Salt. Mon., vol. iv, pl. xlii, figs. 14, 15. **SIL.**
— *biforata*, Schl. Sil. Mon., vol. iii, p. 268, pl. xxxviii, figs. 11—25. Sil. Sup., vol. v, p. 181. **SIL.**
— *biloba*, Linné. Sil. Mon , vol. iii, p. 206, pl. xxvi, figs. 10—15. Sil. Sup., vol. v, p. 180. **SIL.**
— *Bouchardi*, Dav. Sil. Mon., vol. iii, p. 209, pl. xxvi, figs. 16—23. **SIL.**
— *Budleyensis*, Dav. (under the mistaken name of O. *reduæ*, Barrande). Sil. Mon., vol. iii, p. 224, pl. xxviii, figs. 6—9. Bud.-Salt. Mon., vol. iv, p. 358, pl. xlii, figs. 16—25. **SIL.**
— ? (or Strophomena) *Champernowni*, Dav. Dev. Sup., vol. v, p. 52, pl. iii, fig. 18. **DEV.**
— *calligramma*, Dalman. Sil. Mon., vol. iii, p. 240, pl. xxxv, figs. 1—17. Sil. Sup. vol. v, p. 181, pl. xiii, figs. 23—26. **SIL.**
— — var. *Davidsoni*, de Vern. Sil. Mon., vol. iii, p. 240, pl. xxxv, figs. 18, 19. **SIL.**
— — var. *Scotica*, Salter. Sil. Mon., vol. iii, p. 140, pl. xxxv, figs. 20, 22. **SIL.**
— — var. *virgata*, Salter. Sil. Mon., vol. iii, p. 240, pl. xxxv, figs. 23, 24. **SIL.**
— *canaliculata*, Lindström. Sil. Mon , vol. iii, p. 218, pl. xxvii, figs. 12, 13. **SIL.**
— *Carausii*, Salter. Sil. Mon., vol. iii, p. 229, pl. xxxiii, figs. 1—7. Sil. Sup., vol. v, p. 182, pl. xiv, figs. 21—27. **SIL.**
— *confinis*, Salter. Sil. Mon., vol. iii, p. 266, pl. xxxvi, figs. 1—4. Sil. Sup., vol. v, p. 180. **SIL.**
— *Cornubieenis*, Tromelin ; see Orthis *Berthosi* var. *Cornubieenis*.
— *crassa*, Lindström. Sil. Mon , vol. iii, p. 213, pl. xxvii, figs. 17—19. **SIL.**
— *crispa*, M'Coy. Sil. Mon., vol. iii, p. 256, pl. xxxviii, figs. 5—10. Sil. Sup., vol. v, p. 176, pl. xiii, figs. 7, 8. **SIL.**
— ? *Crofti*, Dav. Sil. Sup., vol. v, p. 179, pl. xiii, figs. 18, 19. **SIL.**
— *Davidsoni*, de Vern ; see Orthis *calligramma* var. *Davidsoni*.
— *Edgelliana*, Salter. Sil. Mon., vol. iii, p. 228, pl. xxxii, figs. 1—4. **SIL.**
— *Eifliensis*, de Vern. Dev. Sup., vol. v, p. 50, pl. iii, fig. 16. **DEV.**
— *elegantula*, Dal. Sil. Mon., vol. iii, p. 211, pl. xxvii, figs. 1—9. Sil. Sup., vol. v, p. 178. **SIL.**
— *elegantulina*, Dav. Sil. Sup., vol. v, p. 219, pl. xiii, fig. 17. **SIL.**
— *erratica*, Dav. ; see Orthis *Berthosi* var. *erratica*.
— *flabellulum*, Sow. Sil. Mon , vol. iii, p. 248, pl. xxxiv, figs. 1—12. Sil. Sup., vol. v, p. 179, pl. xiii, figs. 3—6, and 20, 21. **SIL.**
— *fallax*, Salter. Sil. Mon., vol. iii, p. 223, pl. xxxi, figs. 9—11. **SIL.**
— *Girvaniensis*, Dav. Sil. Mon., vol. iii, p. 216, pl. xxviii, fig. 10. **SIL.**
— *granulosa*, Phil. Dev. Mon., vol. iii, p. 92, pl. xvii, fig. 24. **DEV.**
— *Hamoni*, Rouault. Bud.-Salt. Mon., vol. iv, p. 344, pl. xxxviii, fig. 20. **DEV.**

Orthis *Hicksii*, Salter. Sil. Mon., vol. iii, p. 230, pl. xxxiii, figs. 13—16. Sil. Sup. vol. v, p. 184. **SIL.**

— *hipparionix*, Vanuxem. Dev. Mon., vol. iii, p. 90, pl. xvii, figs. 8—11. Bud.-Salt. Mon., vol. iv, p. 347, pl. xxxix, fig. 1. **DEV.**

— ? *Hirmantensis*, M'Coy. Sil. Mon., vol. iii, p. 261, pl. xxxii, figs. 5—9. Sil. Sup., vol. v, p. 184, pl. xi, figs. 8—11. **SIL.**

— *hybrida*, Sow. Sil. Mon., vol. iii, p. 214, pl. xxvii, figs. 15, 16. **SIL.**

— *intercostata*, Portlock. Sil. Mon., vol. iii, p. 236, pl. xxxviii, figs. 1—4. **SIL.**

— *interlineata*, Sow. Dev. Mon., vol. iii, p. 91, pl. xvii, figs. 18—23. **DEV.**

— *Jonesi*, Dav. Sil. Sup., vol. v, p. 190, pl. xi, figs. 15—17. **SIL.**

— *Keyserlingiana*, de Kon. Carb. Mon., vol. ii, p. 132, pl. xxviii, fig. 14. **CARB.**

— ? *Kilbuchoensis*, Dav. Sil. Sup., vol. v, p. 188, pl. xiii, figs. 1, 2. **SIL.**

— *Lapworthi*, Dav. Sil. Sup., vol. v, p. 176, pl. xiii, figs. 9, 10. **SIL.**

— *lenticularis*, Wahl.? Sil. Mon., vol. iii, p. 230, pl. xxxiii, figs. 22—28. **SIL.**

— *lunata*, Dav. Sil. Mon., vol. iii, p. 215, pl. xxviii, figs. 1—5. **SIL**

— *Menapiæ*, Hicks. Sil. Mon., vol. iii, p. 228, pl. xxxiii, figs. 8—12. **SIL.**

— *Michelini*, L'Eveillé. Carb. Mon., vol. ii, p. 132, pl. xxx, figs. 6—12. Carb. Sup., vol. iv, p. 292, pl. xxxiv, figs. 15—17. **CARB.**

Monnieri, Rouault (=O. *Vicaryi*, Dav.). Bud.-Salt. Mon., vol. iv, p. 345, pl. xl, figs. 1—8. **DEV.**

— *Mullockiensis*, Dav. Sil. Mon., vol. iii, p. 221, pl. xxix, figs. 14—18. Sil. Sup., vol. v, p. 180, pl. xvi, figs. 14, 15. **SIL.**

— *nina*, Dav. Sil. Sup., vol. v, p. 177, pl. xiii, fig. 11. **SIL.**

— *patera*, Salter. Sil. Mon., vol. iii, p. 267, pl. xxx, figs. 1—8. **SIL.**

— *Pengelliana*, Dav. Dev. Sup., vol. v, p. 51, pl. iii, fig. 19. **DEV.**

— *Philipi*, Dav. Sil. Sup., vol. v, p. 188, pl. xi, figs. 13, 14. **SIL.**

— *plicata*, Sow. Sil. Mon., vol. iii, p. 245, pl. xxxv, figs. 25, 26; pl. xxxvii, fig. 1. Sil. Sup., vol. v, p. 182, pl. xiii, fig. 27. **SIL.**

— *polygramma*, var. *Pentlandica*, Dav. Sil. Mon., vol. iii, p. 219, pl. xxix, figs. 1—10. Sil. Sup., vol. v, p. 179. **SIL.**

— *porcata*, M'Coy. Sil. Mon., vol. iii, p. 250, pl. xxxi, figs. 12—20; pl. xlvi, fig. 4. **SIL.**

— *protensa*, Sow. Sil. Mon., vol. iii, p. 257, pl. xxxvi, figs. 24—30. **SIL.**

— *pulvinata*, Salter. Bud.-Salt. Mon., vol. iv, p. 357, pl. xli, figs. 10, 11. **SIL.**

— *Rankini*, Dav. Sil. Sup., vol. v, p. 190, pl. xi, figs. 17—19. **SIL.**

— *redux*, Barrande; see Orthis *Budleyensis*, Dav.

— *resupinata*, Martin. Carb. Mon., vol. ii, p. 130, pl. xxix, figs. 1—6; pl. xxx, figs. 1—5. Carb., Sup., vol. iv, p. 294. **CARB.**

— *retrorsistria*, M'Coy. Sil. Mon., vol. iii, p. 265, pl. xxxvi, figs. 39—42 (only). Sil. Sup., vol. v, p. 185, pl. xiv, figs. 7—16. **SIL.**

— *reversa*, Dav. Sil. Mon., vol. iii, p. 220, pl. xxix, figs. 11—13. Sil. Sup., vol. v, p. 180, pl. xvi, fig. 13. **SIL.**

— *rigida*, Dav.; see Orthis *rustica* var. *rigida*.

— *rustica*, Sow. Sil. Mon., vol. iii, p. 238, pl. xxxiv, figs. 13—17. Sil. Sup., vol. v, p. 178, pl. xxxiv, figs. 13—22. **SIL.**

— — var. *rigida*, Dav. Sil. Mon., vol. iii, p. 238, pl. xxxiv, figs. 18, 19. **SIL.**

— — var. *Walsalliensis*, Dav. Sil. Mon., vol. iii, p. 238, pl. xxxiv, figs. 20—22. **SIL.**

— *sagittifera*, M'Coy. Sil. Mon., vol. iii, p. 260, pl. xxxvi, figs. 18—23. Sil. Sup., vol. v, p. 181, pl. xiii, fig. 29. **SIL.**

Orthis *Salteri*, Dav. Sil. Mon., vol. iii, p. 255, pl. xxxvi, figs. 31—34. **SIL.**
— *sarmentosa*, M'Coy. Sil. Mon., vol. iii, p. 262, pl. xxxvi, figs. 35—38. Sil. Sup., vol. v, p. 189. **SIL.**
— *Scotica*, Salter ; see Orthis *calligramma* var. *Scotica*.
— *simplex*, M'Coy. Sil. Mon., vol. iii, p. 255, pl. xxxii, figs. 10, 11. **SIL.**
— *Sowerbyana*, Dav. Sil. Mon., vol. iii, p. 247, pl. xxxv, figs. 27—31. Sil. Sup., vol. v, p. 178. **SIL.**
— *striatula*, Schl. Dev. Mon., vol. iii, p. 87, pl. xvii, figs. 4—7. **DEV.**
— *testudinaria*, Dalman. Sil. Mon., vol. iii, p. 226, pl. xxviii, figs. 13—16, 22—24 (not 13—15, 17—21). Bud.-Salt. Mon., vol. iv, pl. xlii, fig. 26. Sil. Sup., vol. v, p. 178, pl. xiii, figs. 30, 31. **SIL.**
— *tetragona*, de Vern. Dev. Sup , vol. v, p. 51, pl. iii, fig. 17. **DEV.**
— *tricenaria*, Conrad. Dav. Sil. Mon., vol. iii, p. 276, pl. xxxviii, fig. 28. **SIL.**
— *turgida*, M'Coy. Sil. Mon., vol. iii, p. 258, pl. xxxii, figs. 12—20. Sil. Sup., vol. v, p. 187, pl. xiv, figs. 17—20. **SIL.**
— *unguis*, Sow. Sil. Mon., vol. iii, p. 257, pl. xxxvii, figs. 16—22. Sil. Sup., vol. v, p. 177, pl. xiii, fig. 28? **SIL.**
— *Valpyana*, Dav. Sil. Mon., vol. iii, p. 235, pl. xxxii, figs. 29—33. **SIL.**
— *vespertilio*, Sow. Sil. Mon., vol. iii, p. 236, pl. xxx, figs. 11—21. **SIL.**
— *virgata*, Salter ; see Orthis *calligramma*, var. *virgata*.
— *Walsalliensis*, Dav. ; see Orthis *rustica*, var. *Walsalliensis*.
Orthisina *adscendens*, Pander. Sil. Mon., vol. iii, p. 278, pl. xlix, figs. 27—29. Sil. Sup., vol. v, p. 175, pl. xvi, figs. 16—18. **SIL.**

Paterula *Balcletchiensis*, Dav. (as Discina *Balcletchiensis*). Sil. Sup., vol. v, p. 210, pl. xvii, figs. 41, 42. **SIL.**
Pentamerus *biplicatus*, Schnur. Dev. Mon., vol. iii, p. 73, pl. xiv, figs. 31, 32. Dev. Sup., vol. v, p. 42, pl. ii, fig. 22. **DEV.**
— *brevirostris*, Phil. Dev. Mon., vol. iii, p. 72, pl. xv, figs. 1—14. **DEV.**
— *galeatus*, Dal. Sil. Mon., vol. iii, p. 145, pl. xv, figs. 13—23. Sil. Sup., vol. v, p. 164, pl. ix, fig. 25. **SIL.**
— *globosus*, Sow. Sil. Mon., vol. iii, p. 156, pl. xix, figs. 10—12. Sil. Sup., vol. v, p. 163, pl. ix, figs. 21—24. **SIL.**
— *Knightii*, Sow. Sil. Mon., vol. iii, p. 142, pl. xvi, figs. 1—3 ; pl. xvii, figs. 1—10 ; pl. xix, fig. 3. **SIL.**
— *linguifer*, Sow. Sil. Mon. vol. iii, p. 149, pl. xvii, figs. 11—14. **SIL.**
— *oblongus*, Sow. Sil. Mon., vol. iii, p. 151, pl. xviii, figs. 1—12 ; pl. xix, figs. 1, 2. Sil. Sup., vol. v, p. 161. **SIL.**
— *rotundus*, Sow. Sil. Mon., vol. iii, p. 150, pl. xv, figs. 9—11. Sil. Sup., vol. v, p. 163, pl. ix, figs. 6—9. **SIL.**
— ? *Shallockiensis*, Dav. Sil. Sup., vol. v, p. 164, pl. ix, fig. 26. **SIL.**
— *undatus*, Sow. Sil. Mon., vol. iii, p. 155, pl. xix, figs. 4—9 ; and Sil. Sup., vol. v, p. 162, pl. ix, figs. 10—20. **SIL.**
Pholidops (Crania) *implicatus*, Sow. Sil. Mon., vol. iii, p. 80, pl. viii, figs. 13—18. Sil. Sup., vol. v, p. 216, pl. xvii, fig. 48. **SIL.**
Porambonites *intercedens*, Pander. Sil. Mon., vol. iii, p. 195 (in part), pl. xxv, fig. 16 (not 17—19), pl. xxvi, figs. 1—3. **SIL.**

PRODUCTUS *aculeatus*, Martin. Carb. Mon., vol. ii, pp. 166, 233, pl. xxxiii, figs. 16—20. Carb. Sup., vol. iv, pp. 299, 311, pl. xxx, fig. 10. **CARB.**

— *arcuarius*, de Kon. Carb. Mon., vol. ii, p. 160, pl. xxxiv, fig. 17. **CARB.**

— *carbonarius*, de Kon. Carb. Mon., vol. ii, p. 160, pl. xxxiv, fig. 6. Carb. Sup., vol. iv, p. 309, pl. xxxvi, figs. 7, 8. **CARB.**

— *Carringtonianus*, Dav. Carb. Mon., vol. ii, p. 274, pl. lv, fig. 5. **CARB.**

— *complectens*, Etheridge. Carb. Sup., vol. ii, p. 303, pl. xxxv, figs. 4—13. **CARB.**

— *cora*, d'Orb. Carb. Mon., vol. ii, p. 148, pl. xxxvi, fig. 4; and pl. xlii, fig. 9. Carb. Sup., vol. iv, p. 299. **CARB.**

— *costatus*, Sow. Carb. Mon., vol. ii, p. 152, pl. xxxii, figs. 2—9. Carb. Sup., vol. iv, p. 298, pl. xxxvi, figs. 9, 18—20. **CARB.**

— — var. *muricatus*, Phillips. Carb. Mon., vol. ii, p. 153, pl. xxxii, figs. 10—14. **CARB.**

— *Deshayesianus*, de Kon. Carb. Mon., vol. ii, p. 232, pl. liii, figs. 11, 12. **CARB.**

— *elegans*, M'Coy; see PRODUCTUS *punctatus*, var. *elegans*.

— *ermineus*, de Kon. Carb. Mon., vol. ii, p. 164, pl. xxxiii, fig. 5; and p. 233. **CARB.**

— *fimbriatus*, Sow. Carb. Mon., vol. ii, p. 171, pl. xxxiii, figs. 12—15; and pl. xliv, fig. 15. Carb. Sup., vol. iv, p. 300. **CARB.**

— *giganteus*, Martin. Carb. Mon., vol. ii, p. 141, pl. xxxvii, figs. 1—4; pl. xxxviii, fig. 1; pl. xxxix, figs. 1—5; pl. xl, figs. 1—3. Carb. Sup., vol. iv, p. 297, pl. xxxvi, figs. 1 and 21. **CARB.**

— — var. *hemisphæricus*, Sow. Carb. Mon., vol. ii, p. 144, pl. xl, figs. 4—9. **CARB.**

— *Griffithianus*, de Kon. Carb. Sup., vol. iv, p. 308, pl. xxxvi, fig. 6. **CARB.**

— *hemisphæricus*, Sow; see PRODUCTUS *giganteus*, var. *hemisphæricus*.

— *horridus*, J. Sow. Permian Mon., vol. ii, p. 33, pl. iv, figs. 13—26. Carb. Mon. vol. ii, pl. liv, fig. 44. **PERM.**

— *humerosus*, Sow. Carb. Mon., vol. ii, p. 147, pl. xxxvi, figs. 1, 2 (internal cast)=shell P. *sub-lævis*, p. 177, pl. xxxi, figs. 1, 2; pl. xxxii, fig. 1; pl. li, figs. 1, 2, p. 234. Carb. Sup., vol. iv, p. 306. **CARB.**

— *Keyserlingianus*, de Kon. Carb. Mon., vol. ii, p. 174, pl. xxxiv, figs. 15, 16. **CARB.**

— *Koninckianus*, de Verneuil. Carb. Mon., vol. ii, p. 230, pl. liii, fig. 7. **CARB.**

— *latirostratus*, Howse=*umbonellatus*, King. Perm. Mon. (vol. ii), p. 36, pl. iv, figs. 1—12. **PERM.**

— *latissimus*, J. Sow. Carb. Mon., vol. ii, p. 145, pl. xxxv, figs. 1—4. Carb. Sup., vol. iv, p. 297. **CARB.**

— *Llangollensis*, Dav. (described in vol. ii under the name of CHONETES *comoides*). Carb. Mon., vol. ii, pp. 180, 277, pl. xlv, figs. 1—6 (not 7); pl. lv, figs. 9, 10. Carb. Sup., vol. iv, p. 307. **CARB.**

— *longispinus*, Sow. Carb. Mon., vol. ii, p. 154, pl. xxxv, figs. 5—17. Carb. Sup., p. 298, pl. xxxvi, figs. 14—16.? Dev. Mon., vol. iii, p. 103, pl. xx, fig. 7. **CARB.—DEV.**

— *margaritaceus*, Phil. Carb. Mon., vol. ii, p. 159, pl. xliv, figs. 5—8. **CARB.**

— *marginalis*, de Kon. Carb. Mon., vol. ii, p. 229, pl. liii, fig. 3. **CARB.**

— *mesolobus*, Phillips. Carb. Mon., vol. ii, p. 178, pl. xxxi, figs. 6—9. Carb. Sup., vol. iv, 299. **CARB.**

— *muricatus*, Phillips; see PRODUCTUS *costatus*, var. *muricatus*.

— *Nystianus*, de Kon. Carb. Mon., vol. ii, p. 231, pl. liii, fig. 9. **CARB.**

— *plicatilis*, Sow. Carb. Mon., vol. ii, p. 176, pl. xxxi, figs. 3—5. **CARB.**

— *prælongus*, Sow. Dev. Mon., vol. iii, p. 102, pl. xix, figs. 22—25. **DEV.**

Productus *proboscideus*, de Vern. Carb. Mon., vol. ii, p. 163, pl. xxxiii, figs. 1—4. Carb. Sup., vol. iv, p. 311, pl. xxxvi, fig. 13. **CARB.**

— *punctatus*, Martin. Carb. Mon., vol. ii, p. 172, pl. xliv, figs. 9—16. Carb. Sup., vol. v, p. 298. **CARB.**

— — var. *elegans*, M'Coy. Carb. Mon., vol. ii, p. 173, pl. xliv, fig. 15. **CARB.**

— *pustulosus*, Phillips. Carb. Mon., vol. ii, p. 168, pl. xli, figs. 1—6; pl. xlii, figs. 1—4. Carb. Sup., vol. iv, p. 300. **CARB.**

— *scabriculus*, Martin. Carb. Mon., vol. ii, p. 169, pl. xlii, figs. 5—8. Carb. Sup., vol. iv, pp. 300, 308, pl. xxxv, fig. 3; pl. xxxvi, fig. 22. Dev. Mon., vol. iii, p. 103, pl. xx, figs. 3—5? **CARB.**

— *semireticulatus*, Martin. Carb. Mon., p. 149, pl. xliii, figs. 1—11; and pl. xliv, figs. 1—4, var. *Martini*, pl. xliii, fig. 6. Carb. Sup., vol. iv, pp. 297, 307; pl. xxxv, figs. 1, 2; pl. xxxvi, figs. 12, 17. **CARB.**

— *sinuatus*, de Kon. Carb. Mon., vol. ii, p. 157, pl. xxxiii, figs. 8—11. Carb. Sup. vol. iv, p. 299. **CARB.**

— *spinulosus*, Sow. Carb. Mon., vol. ii, p. 175, pl. xxxiv, figs. 18—21. Carb. Sup., vol. iv, p. 299, pl. xxxvi, fig. 11. **CARB.**

— *striatus*, Fischer. Carb. Mon., vol. ii, p. 139, pl. xxxiv, figs. 1—5; and p 232, pl. liii, fig. 4. **CARB.**

— *subaculeatus*, Murch. Dev. Mon., vol. iii, p. 99, pl. xx, figs. 1, 2. Dev. Sup., vol. v, p. 54, pl. iii, fig. 22. **DEV.**

— *sub-lævis*, de Kon. (a synonym of P. *humerosus*). Carb. Mon., vol. ii, pp. 177, 234, pl. xxxi, figs. 1, 2; pl. xxxii, fig. 1; pl. li, figs. 1, 2. **CARB.**

— *tessellatus*, de Kon. Carb. Mon., vol. ii, p. 165, pl. xxxiii, figs. 24, 25; pl. xxxiv, fig. 14. Carb. Sup., vol. iv, p. 310, pl. xxxvi, figs. 3—5. **CARB.**

— *undiferus*, de Kon. Carb. Mon., vol. ii, p. 230, pl. liii, figs. 5, 6. **CARB.**

— *undatus*, Def. Carb. Mon., vol. ii, p. 161, pl. xxxiv, figs. 7—13. Carb. Sup., vol. iv, p. 300. **CARB.**

— *Vicaryi*, Salter sp. Bud.-Salt. Mon., vol. iv, p. 351, pl. xxxix, figs. 14, 15. **DEV.**

— *Wrightii*, Dav. Carb. Mon., vol. ii, p. 162, pl. xxxiii, figs. 6, 7. **CARB.**

— *Youngianus*, Dav. Carb. Mon., vol. ii, pp. 167, 233, pl. xxxiii, figs. 21—23. Carb. Sup., vol. iv, p. 299. **CARB.**

Rensselæria ? *striatissima*, Dav. Dev. Sup., vol. v, p. 19, pl. i, fig. 20. **DEV.**

— *stringiceps?* F. Roemer. Dev. Mon., vol. iii, p. 10, pl. iv, figs. 5—7. **DEV.**

Reticularia (Spirifera) *lineata*, Martin. Carb. Mon., vol. ii, p. 62, pl. xiii, figs. 4—10; p. 225, pl. li, fig. 15. Carb. Sup., vol. iv, p. 275, pl. xxxii, figs. 6—11; pl. xxxiv, figs. 8, 9. Dev. Mon., vol. iii, p. 43, pl. iv, figs. 13—16. Dev. Sup., vol. v, pl. ii, fig. 5. **CARB.—DEV.**

— — var. *elliptica*, Phillips. Carb. Mon., vol. ii, p. 63, pl. xiii, figs. 1—3. **CARB.**

— — var. *reticulata*, Sow. Carb. Mon., vol. ii, pl. xiii, figs. 11—13. **CARB.**

Retzia *Baylei*, Dav.; see Retzia *Salteri*, var. *Baylei*.

— *Bouchardi*, Dav.; see Retzia *Salteri*, var. *Bouchardi*.

— *carbonaria*, Dav. Carb. Mon., vol. ii, p. 219, pl. li, fig. 3. Carb. Sup., vol. iv, p. 283, pl. xxx, fig. 16. **CARB.**

— *longirostris*, Kayser (not R. *ferita*, von Buch.). Dev. Mon., vol. iii, p. 21, pl. iv, figs. 8—10. Dev. Sup., vol. v, p. 29, pl. i, figs. 30, 31. **DEV.**

Retzia (Eumetria?) *radialis*, Phillips. Carb. Mon., vol. ii, p. 87, pl. xvii, figs. 19, 20, pl. li, figs. 4—9; and Carb. Sup., vol. iv, p. 218, pl. li, figs. 4—9. **CARB.**

— *Salteri*, Dav. Sil. Mon., vol. iii, p. 125, pl. xii, figs. 21, 22; and Sil. Sup., vol. v, p. 92, pl. iv, figs. 12—14. **SIL.**

— — var. *Baylei*, Dav. Sil. Mon., vol. iii, p. 127, pl. xii, figs. 23, 25, 27. **SIL.**

— — var. *Bouchardi*, Dav. Sil. Mon., vol. iii, p. 127, pl. xii, figs. 26—30. **SIL.**

— (Eumetria?) *ulotrix*, de Kon. Carb. Mon., vol. ii, pp. 88, 218, pl. xviii, figs. 14, 15. **CARB.**

Rhynchonella *acuminata*, Martin. Carb. Mon., vol. ii, p. 93, pl. xx, figs. 1—13; pl. xxi, figs. 1—13. Dev. Mon., vol. iii, p. 60, pl. xiii, figs. 1—4, 5? **CARB.—DEV.**

— — var. *platiloba*, Sow. Carb. Mon., vol. ii, p. 93, pl. xxi, figs. 14—20. Dev. Sup., vol. iv, p. 47. **DEV.**

— *acuta*, Sow. Ool. Mon., vol. i, p. 76, pl. xiv, figs. 8, 9. Ool. Sup., vol. iv, p. 203.

— *æmula*, Salter. Sil. Mon., vol. iii, p. 188, pl. xxiv, fig. 21. Sil. Sup., vol. v, p. 160, pl. x, fig. 17? **SIL.**

— *Amalthei*, Quenstedt. Ool. Sup., vol. iv, p. 200, pl. xxviii, figs. 18—21? **JUR.**

— *angularis*, Phil. Dev. Mon., vol. iii, p. 68, pl. xiv, figs. 11—13. **DEV.**

— *angulata*, Linné. Carb. Mon., vol. ii, p. 107, pl. xix, figs. 11—16. **CARB.**

— *angulata*,[1] Sow., and *subangulata*, Dav.; see Rhynchonella *angulina* and Rh. *sub-angulina*.

— *angulina*, Dav. (under the name of *angulata*, Sow.). Ool. Mon., vol. i, p. 92, pl. xvii, fig. 13. Ool. Sup., vol. iv, p. 207. **JUR.**

— var. *sub-angulina*, Dav. (under the name of *sub-angulata*, Dav.). Ool. Sup., vol. iv, p. 208, pl. xxix, figs. 14—16. **JUR.**

— *anisodonta*, Phil. (as part of R. *pugnus*). Dev. Mon., vol. iii, p. 63, pl. xii, figs. 12—14; and Dev. Sup., vol. v, p. 46. **DEV.**

— *antidichotoma*, Dav. Cret. Sup., vol. iv, p. 65, pl. viii, figs. 19—21. **CRET.**

— *Balcletchiensis*, Dav. Sil. Sup., vol. v, p. 160, pl. x, figs. 15, 16, and p. 200, pl. xi, fig. 23. **SIL.**

— *Balinensis*, Suess MS. App. to Sup., vol. v, p. 277, pl. xx, fig. 3. **JUR.**

— *Beltiana*, Dav. Sil. Mon., vol. iii, p. 189, pl. xxiv, fig. 22. **SIL.**

— *Benecki*, Haas? App. to Sup., vol. v, p. 274, pl. xx, figs. 8—10. **JUR.**

— *bidentata*, Hisinger (as part of R. *borealis*). Sil. Mon., vol. iii, p. 174, pl. xxi, fig. 22. Sil. Sup., vol. v, p. 150, pl. x, fig. 3. **SIL.**

— *bifera*, Phil. Dev. Mon., vol. iii, p. 64, pl. xii, figs. 10, 11. **DEV.**

— *bilobata*, S. Buck. App. to Sup., vol. v, p. 272, pl. xix, figs. 18, 19. **JUR.**

— *borealis*, Schl. Sil. Mon., vol. iii, p. 174, pl. xxi, figs. 14—27 (excluding figs. 23 and 22, which belong to Rh. *diodonta*, and to Rh. *bidentata*; these are not synonyms of R. *borealis*). Sil. Sup., vol. v, p. 148, pl. x, fig. 25. **SIL.**

— *Bouchardii*, Dav. Ool. Mon., vol. i, p. 82, pl. xv, figs. 3—5. Ool. Sup., vol. iv, p. 205, pl. xxix, fig. 19. **JUR.**

— *Boueti*, Dav. Ool. Sup., vol. iv, p. 197, pl. xxvi, figs. 15, 16. **JUR.**

— *Bradfordiensis*, Walker; see Rhynchonella *spinosa*, var. *Bradfordiensis*.

— *Brockleyensis*, Dav. Carb. Sup., vol. iv, p. 285, pl. xxxiv, fig. 14. **CARB.**

— *buteo*, Suess MS. App. to Sup., vol. v, p. 276, pl. xx, fig. 7. **JUR.**

[1] Linné's and Sowerby's similar names for the two species having been inadvertently preserved, it has been found necessary to distinguish the two species in the present index.

RHYNCHONELLA *calcicosta*, Quenstedt. Ool. Sup., vol. iv, p. 220, pl. xxviii, figs. 24—33. **JUR.**
— *Callawayana*, Dav. Sil. Sup., vol. v, p. 159, pl. x, fig. 18. **SIL.**
— *Cantabrigensis*, Dav. Cret. Sup., vol. iv, p. 68, pl. viii, fig. 30. **CRET.**
— *capitulata*, Tate. Ool. Sup., vol. iv, p. 222, pl. xxvii, figs. 11, 12. **JUR.**
— ? *Carringtoniana*, Dav. Carb. Mon., vol. ii, p. 227, pl. xxiii, fig. 22; pl. liii, figs. 1, 2. **CARB.**
— *Carteri*, Dav. (not *lineolata*). Cret. Mon., vol. i, p. 98, pl. xii, figs. 7—10. Cret. Sup., vol. iv, p. 60. **CRET.**
— *concinna*, Sow. Ool. Mon., vol. i, p. 88, pl. xvii, figs. 6—12. Ool. Sup., vol. iv, p. 205, pl. xxvii, fig. 22. **JUR.**
— — var. *Yaxleyensis*, Dav. Ool. Sup., vol. iv, p. 206, pl. xxvii, fig. 23. **JUR.**
— *contraria*, Roemer (under the mistaken name of RH. *Wettoniensis*, Dav.). Carb. Mon., vol. ii, p. 274, pl. lv, figs. 1—3. **CARB.**
— *convexa*, Sow.; see RHYNCHONELLA *dimidiata*, var. *convexa*.
— *cordiformis*, Sow. Carb. Mon., vol. ii, p. 92, pl. xix, figs. 8—10 (not pl. viii, ix, given by mistake). **CARB.**
— ? *coronata*, Moore. Ool. Sup., vol. iv, p. 218, pl. xxvii, fig. 13. **JUR.**
— *Crossi*, Walker. Ool. Sup., vol. iv, p. 223, pl. xxvii, fig. 17. **JUR.**
— *cuboides*, Sow. Dev. Mon., vol. iii, p. 65, pl. xiii, figs. 16—21. Dev. Sup., vol. v, p. 46, pl. ii, figs. 18, 19. **DEV.**
— *cuneata*, Dalman. Sil. Mon., vol. iii, p. 164, pl. xxi, figs. 7—11. Sil. Sup., vol. v, p. 152, pl. x, figs. 9, 10. **SIL.**
— *cuneatella*, Dav. Sil. Sup., vol. v, p. 200, pl. x, fig. 11. **SIL.**
— *Cuvieri*, d'Orb. Cret. Mon., vol. i, p. 88, pl. x, figs. 50—54. Cret. Sup., vol. iv, p. 58. **CRET.**
— *cynocephala*, Richard. Ool. Mon., vol. i, p. 77, pl. xiv, figs. 10—12. Ool. Sup., vol. iv, p. 204. **JUR.**
— *Davidsoni*, M'Coy; see RHYNCHONELLA *Wilsoni*, var. *Davidsoni*.
— *Dayi*, Dav. Sil. Sup.. vol. v, p. 152, pl. x, fig. 2. **SIL.**
— *decemplicata*, Dav. Sil. Mon., vol. iii, p. 177, pl. xxiii, fig. 20—24; p. 202, pl. xi, fig. 27. Sil. Sup., vol. v, pp. 151, 202, pl. xi, fig. 27. **SIL.**
— *deflexa*, Sow. Sil. Mon., vol. iii, p. 156, pl. xxii, figs. 24—27. Sil. Sup., vol. v, p. 156. **SIL.**
— *depressa*, Sow. Cret. Mon., vol. i, p. 89, pl. xi, figs. 28—32; pl. xii, fig. 26 (not 28—30?). Cret. Sup., vol. iv, p. 58, pl. viii, figs. 24, 25. Appendix to Sup., vol. v, p. 252. **CRET.**
— *dimidiata*, Sow. Cret. Mon., vol. i, p. 80, pl. xi, figs. 1—5; pl. xii, fig. 25 (not R. *compressa*, Lam.). Cret. Sup., vol. iv, p. 60. **CRET.**
— — var. *convexa*, Sow. Cret. Mon., vol. i, pl. xi, figs. 6—14; pl. xii, fig. 24. Cret. Sup., vol. iv, p. 62. **CRET.**
— *diodonta*, Dav. Sil. Sup., vol. v, p. 151, pl. x, fig. 4. **SIL.**
— *Dorsetiensis*, S. Buck. App. to Sup., vol. v, p. 277, pl. xx, fig. 2. **JUR.**
— *Dumbletonensis*, Dav.; see RHYNCHONELLA *tetrahedra*, var. *Dumbletonensis*.
— *Dundriensis*, S. Buck. App. to Sup., vol. v, p. 272, pl. xix, fig. 20. **JUR.**
— *egretta*, E. Desl. Ool. Sup., vol. iv, p. 216, pl. xxviii, fig. 23. **JUR.**
— *Edgelliana*, Dav. Sil. Mon., vol. iii, p. 190, pl. xxiv, figs. 27, 28. **SIL.**
— *fallax*, E. Desl. App. to Sup., vol. v, p. 275, pl. xx, figs. 4, 5. **JUR.**
— *flexistria*, Phillips. Carb. Mon., vol. ii, p. 105, pl. xxiv, figs. 1—8. **CARB**

RHYNCHONELLA *fodinalis*, Tate. Ool. Sup., vol. iv, p. 206, pl. xxviii, figs. 39—41. **JUR.**

— *Forbesii*, Dav. Ool. Mon., vol. i, p. 84, pl. xvii, fig 9. Ool. Sup., vol. iv, p. 205. **JUR.**

— *furcillata*, Theodori. Ool. Mon., vol. i, p. 69, pl. xiv, figs. 2—5; and Ool. Sup., vol. iv, p. 189, pl. xxvii, figs. 1—3. **JUR.**

— *Gibbsiana*, Sow. Cret. Mon., vol. i, p. 98, pl. xii, figs. 11, 12. Cret. Sup., vol. iv, p. 67. **CRET.**

— *Gingensis*, Waagen. App. to Sup., vol. v, p. 275, pl. xx, fig. 1. **JUR.**

— *Girvaniensis*, Dav. Sil. Sup., vol. v, p. 155, pl. x, fig. 26. **SIL.**

— *Glassiana*, Dav. (as ATRYPA *depressa*, Sow.). Sil. Mon., vol. iii, p. 123, pl. xii, figs. 11—15; pl. xiii, fig. 6. Sil. Sup., vol. v, p. 155, pl. x, fig. 22. **SIL.**

— *Glassii*, Dav. Carb. Sup., vol. iv, p. 285, pl. xxxiii, fig. 10. **CARB.**

— *Glevensis*, Smithe. Ool. Sup., vol. iv, p. 221, pl. xxviii, fig. 22. **JUR.**

— *Grasiana*, d'Orb. Cret. Mon., vol. i, p. 96, pl. xii, figs. 17—19. Cret. Sup., vol. iv, p. 57. **CRET.**

— ? *gregaria*, M'Coy. Carb. Mon., vol. ii, p. 112, pl. xv, figs. 27, 28. **CARB.**

— *inaurita*, Sandb. Bud.-Salt. Mon., vol. iv, p. 341, pl. xxxviii, fig. 35. **DEV.**

— *inconstans*, Sow. Ool. Mon., vol. i, p. 87, pl. xviii, figs. 1—4; and Ool Sup., vol. iv, p. 191, pl. xxvi, figs. 1—6. **JUR.**

— *inflexa*, Sow. Dev. Mon., vol. iii, p. 67, pl. xiv, figs. 7—10. **DEV.**

— *Jackii*, Dav. Sil. Sup., vol. v, p. 158, pl. ix, fig. 3. **SIL.**

— *jurensis*, Quenstedt. Ool. Sup., vol. iv, p. 224, pl. xxvii, figs 24—27. **JUR.**

— *lacunosa*, Schl. Ool. Sup., vol. iv, p. 196, pl. xxvi, figs. 13, 14. **JUR.**

— *Lapworthi*, Dav. Sil. Sup., vol. v, p. 154, pl. x, fig. 7. **SIL.**

— *laticosta*, Phil. Dev. Mon., vol. iii, p. 61, pl. xiv, figs. 1—3. **DEV.**

— *latissima*, Sow. (lata). Cret. Mon. vol. i, p. 82, pl. xi, figs. 15—22 (not 6—14, nor pl. xii, figs. 24, 28—30). Cret. Sup., vol. iv, p. 62. **CRET.**

— *Leedsii*, Walker. Ool. Sup., vol. iv, p. 216, pl. xxviii, fig. 17. **JUR.**

— *Leei*, Dav. Dev. Sup., vol. v, p. 47, pl. ii, fig. 15. **DEV.**

— *Lewisii*, Dav. Sil. Mon., vol. iii, p. 180, pl. xxiii, figs. 25—28. **SIL.**

— *limbata*, Schl. Cret. Mon., vol. i, p. 79, pl. xii, figs. 1—5. **CRET.**

— — var. *robusta*, Tate. Cret. Sup., vol. iv, p. 57, pl. vii, fig. 18. **CRET.**

— *lineata*, Young and Bird. Ool. Mon., vol. i, pl. xvi, figs. 1—3 (only). Ool. Sup., vol. iv, p. 209, pl. xxix, figs. 17, 18. **JUR.**

— — var. *Radstockiensis*, Dav. Ool. Mon., vol. iv, p. 210, pl. xvi, figs. 4—6. **JUR.**

— *lineolata*, Phillips. Cret. Mon. vol. i, p. 98, pl. xii, fig. 6 (only). Cret. Sup., vol. iv, p. 59. **CRET.**

— *Llandoveriana*, Dav. Sil. Mon., vol. iii, p. 184, pl. xxiv, figs. 8—13. Sil. Sup., vol. v, p. 157, pl. x, figs. 32—37. **SIL.**

— ? *Lopensis*, Moore. Ool. Sup., vol. iv, p. 217, pl. xxvii, figs. 8, 9. **JUR.**

— ? *Lummatoniensis*, Dav. Dev. Mon., vol. iii, p. 70, pl. xiv, figs. 14—18. **DEV.**

— *Lycettii*, Dav. Ool. Mon., vol. i, p. 81, pl. xv, fig. 6. Ool. Sup., vol. iv, p. 203. **JUR.**

— *Maccoyana*, Dav. Sil. Mon., vol. iii, pl. xxv, figs. 17—19 (not 16, or pl. xxvi, figs. 1—3). Sil. Sup., vol. v, p. 161, pl. viii, fig. 33. **SIL.**

— *Mantelliana*, Sow. Cret. Mon., vol. i, p. 87, pl. xii, figs. 20—23. Cret. Sup., vol. iv, p. 58. **CRET.**

— *Martini*, Mantell. Cret. Mon., vol. i, p. 94, pl. xii, figs. 15, 16. Cret. Sup., vol. iv, p. 57. **CRET.**

RHYNCHONELLA *Moorei*, Dav. Ool. Mon., vol. i, p. 82, pl. xv, figs. 11—14. Ool. Sup., vol. iv, p. 203. **JUR.**

— *Morierei*, Dav. Ool. Mon., vol. i, p. 92, pl. xviii, figs. 12, 13. Ool. Sup., vol. iv, p. 225. **JUR.**

— *multiformis*, Roemer (pars). Cret. Sup., vol. iv, p. 63, pl. viii, figs. 22, 23. **CRET.**

— ? *nana*, Salter. Sil. Mon., vol. iii, p. 192, pl. xxiv, fig. 26. **SIL.**

— *nasuta*, M'Coy. Sil. Mon., vol. iii, p. 173, pl. xxiii, fig. 19. Sil. Sup., vol. v, p. 160, pl. x, figs. 20, 21? **SIL.**

— *Northamptonensis*, Dav.; see RHYNCHONELLA *tetrahedra*, var. *Northamptonensis*.

— *nuciformis*, Sow. Cret. Mon., vol. i, p. 93, pl. x, figs. 23—27 (not pl. xii, fig. 27). Cret. Sup., vol. iv, p. 66. **CRET.**

— *nucula*, Sow. Sil. Mon., vol. iii, p. 181, pl. xxiv, figs. 1—7. Sil. Sup., vol. v, p. 157, pl. x, figs. 27—29. **SIL.**

— *obsoleta*, Sow. Ool. Mon., vol. i, p. 90, pl. xvii, figs. 1—5. Ool. Sup., vol. iv, p. 207, pl. xxix, fig. 4. **JUR.**

— *octoplicata*, Sow.; see RHYNCHONELLA *plicatilis*, var. *octoplicata*.

— *Ogwelliensis*, Dav. Dev. Mon., vol. iii, p. 69, pl. xiv, figs. 23—26. Dev. Sup., vol. v, p. 44, pl. ii, fig. 16. **DEV.**

— *oolitica*, Dav. Ool. Mon., vol. i, p. 81, pl. xiv, fig. 7. Ool. Sup., vol. iv, p. 205. **JUR.**

— ? *ovalis*, Dav. Bud.-Salt. Mon., vol. iv, p. 344, pl. xxxviii, figs. 36, 37. **DEV.**

— *oxynoti*, Quenstedt. Ool. Sup., vol. iv, p. 210, pl. xxviii, figs. 37, 38. **JUR.**

— *palma*, Szajnocha. App. to Sup., vol. v, p. 271, pl. xix, fig. 21. **JUR.**

— *parallelepida*, Bronn. (*Rh. primipilaris*, Dav., not of Buch.). Dev. Mon., vol. iii, p. 66, pl. xiv, figs. 4—6. Dev. Sup., vol. v, p. 42. **DEV.**

— *parvirostris*, Sow. Cret. Mon., vol. i, p. 97, pl. xii, figs. 13, 14. Cret. Sup., vol. iv, p. 67, pl. viii, fig. 29. **CRET.**

— *parvula*, E. Desl. Ool. Sup. vol. iv, p. 219, pl. xxvii, fig. 21. **JUR.**

— *Peachii*, Dav. Sil. Sup., vol. v, p. 201, pl. xi, fig. 25. **SIL.**

— *pectunculoides*, Etalon; see RHYNCHONELLA *pinguis*, var. *pectunculoides*.

— *Pengelliana*, Dav. Dev. Mon., vol. iii, p. 61, pl. xii, figs. 8, 9. **DEV.**

— *Pentlandica*, Haswell. Sil. Mon., vol. iii, p. 187, pl. xxii, figs. 9—19. **SIL.**

— *Phillipsii*, Dav. Dev. Sup., vol. v, p. 43, pl. ii, fig. 14. **DEV.**

— *pinguis*, Roemer. Ool. Sup., vol. iv, p. 193, pl. xxvi, fig. 7. **JUR.**

— — var. *pectunculoides*, Etalon. Ool. Sup., vol. iv, p. 194, pl. xxvi, figs. 8—12. **JUR.**

— *platiloba*, Sow.; see RHYNCHONELLA *acuminata*, var. *platiloba*.

— *pleurodon*, Phillips. Carb. Mon., vol. ii, p. 101, pl. xxiii, figs. 1—15; 16—22? Dev. Mon., vol. iii, p. 62, pl. xiii, figs. 12, 13. **CARB.—DEV.**

— *plicatilis*, Sow. Cret. Mon., vol. i, p. 75, pl. x, figs. 37—42. Cret. Sup., vol. iv, p. 57. **CRET.**

— — var. *octoplicata*, Sow. Cret. Mon., vol. i, p. 77, pl. x, figs. 1—17. **CRET.**

— — var. *Woodwardii*, Dav. Cret. Mon., vol. i, p. 77, pl. x, figs. 43—46. **CRET.**

— *plicatella*, Sow. Ool. Mon., vol. i, p. 86, pl. xvi, figs. 7, 8; and Ool. Sup., vol. iv, p. 190, pl. xxvii, figs. 4—7. **JUR.**

— *Portlandica*, Blake. App. to Sup., vol. v, p. 273, pl. xx, fig. 6. **JUR.**

— *Portlockiana*, Dav. Sil. Mon., vol. iii, p. 189, pl. xxiv, figs. 23—25. Sil. Sup., vol. v, p. 159, pl. x, figs. 12—14. **SIL.**

— *primipilaris*, Dav.; see RHYNCHONELLA *parallelepida*.

— ? *proava* (? CAMAROPHORIA), Phil. Carb. Mon., vol. ii, p. 111, pl. xxv, fig. 10. **CARB.**

RHYNCHONELLA ? *protracta*, Sow. = *proboscidialis*, Phil. Dev. Mon. vol. iii, p. 69, pl. xiv, figs. 27—29. Dev. Sup., vol. v, p. 44, pl. ii, fig. 17. **DEV.**

— *psittacea*, Chemnitz. Recent Sup., vol. iv, p. 8, pl. iv. Tert. Mon., vol. i, p. 21, pl. i, fig. 7. Tert. Sup., vol. iv, p. 16, pl. ii, fig. 5. **REC.—TERT.**

— *pugnus*, Martin. Carb. Mon., vol. ii, p. 97, pl. xxii, figs. 1—15. Dev. Mon., vol. iii, p. 63, pl. xii, figs. 12—14; pl. xiii, figs. 8—10. **CARB.—DEV.**

— *pygmæa*, Morris. Ool. Mon., vol. i, p. 57, pl. xiii, fig. 16. Ool. Sup., vol. iv, p. 202. **JUR.**

— *quadriplicata*, Zeiten. Ool. Mon. Appendix to vol. i, p. 23, pl. A, fig. 22; and Ool. Sup., vol. iv, p. 201, pl. xxix, figs. 1—3. **JUR.**

— *reflexa*, de Kon. Carb. Sup., vol. iv, p. 284, pl. xxxiii, figs. 7—9. **CARB.**

— *reniformis*, Dav. Carb. Mon., vol. ii, p. 90, pl. xix, figs. 1—7. Dev. Mon., vol. iii, p. 62, pl. 13, figs. 6, 7. **CARB.—DEV.**

— *rimosa*, v. Buch. Ool. Mon., vol. i, p. 70, pl. xiv, fig. 6. Ool. Sup., vol. iv, p. 189, pl. xxvii, fig. 10. **JUR.**

— *ringens*, Herault. Ool. Mon., vol. i, p. 74, pl. xiv, figs. 13—16. Ool. Sup., vol. iv, p. 204, pl. xxvii, figs. 14—16. **JUR.**

— *robusta*, Tate; see RHYNCHONELLA *limbata*, var. *robusta*.

— *Salteri*, Dav. Sil. Mon., vol. iii, p. 188, pl. xxiv, figs. 19, 20. **SIL.**

— *Schlœnbachi*, Dav. (not *depressa*). Cret. Mon., vol. i, pl. xii, figs. 28—30. Cret. Sup., vol. iv, p. 59. **CRET.**

— *Scotica*, Dav. Sil. Sup., vol. v, p. 201, pl. xi, fig. 26. **SIL.**

— ? *semisulcata*, M'Coy. Carb. Mon., vol. ii, p. 111, pl. xxv, fig. 13. **CARB.**

— *senticosa*, von Buch. Ool. Mon., vol. i, p. 73, pl. xv, fig. 21. Ool. Sup., vol. iv, p. 223. **JUR.**

— *serrata*, Sow. Ool. Mon., vol. i, p. 85, pl. xv, figs. 1, 2. Ool. Sup., vol. iv, p. 189. **JUR.**

— *Shallockiensis*, Dav. Sil. Sup., vol. v, p. 154, pl. x, fig. 19. **SIL.**

— *Smithii*, Walker; see RHYNCHONELLA *varians*, var. *Smithii*.

— *socialis*, Phillips; see RHYNCHONELLA *varians*, var. *socialis*.

— *spathica*, Lamarck; see RHYNCHONELLA *varians*, var. *spathica*.

— *Speetonensis*, Dav. Cret. Sup., vol. iv, p. 69, pl. viii, fig. 32. **CRET.**

— *sphæroidalis*, M'Coy; see RHYNCHONELLA *Wilsoni*, var. *sphæroidalis*.

— *sphærica*, Sow. Dev. Mon., vol. iii, p. 66, pl. xiii, fig. 14. **DEV.**

— *spinosa*, Schl. Ool. Mon., vol. i, p. 71, pl. xv, figs. 15—20. Ool. Sup., vol. iv, p. 222. **JUR.**

— — var. *Bradfordiensis*, Walker. Ool. Sup., vol. iv, p. 222, pl. xxvii, figs. 18, 19. **JUR.**

— *Stephensi*, Dav. Ool. Sup., vol. iv, p. 220, pl. xxvii, fig. 20. **JUR.**

— *Stricklandii*, Sow. Sil. Mon., vol. iii, p. 166, pl. xxi, figs. 1—6 and 28. **SIL.**

— *subangulata*, Dav.; see RHYNCHONELLA *angulata*, var. *subangulata*.

— *sub-borealis*. Sil. Sup., vol. v, p. 149, pl. x, figs. 5, 6. **SIL.**

— *sub-concinna*, Dav. Ool. Mon., vol. i, p. 90, pl. xvii, fig. 17. Ool. Sup., vol. iv, p. 206. **JUR.**

— *sub-decorata*, Dav. Ool. Mon., vol. i, pl. xviii, fig. 10; and Appendix to vol. i, p. 21, pl. A, figs. 23—26; Ool. Sup., vol. iv, p. 201. **JUR.**

— *sub-obsoleta*, Dav. Ool. Mon., vol. i, p. 91, pl. xvii, fig. 14. Ool. Sup., vol. iv, p. 207. **JUR.**

RHYNCHONELLA *subreniformis*, Schnur. Dev. Sup., vol. v, p. 45. **DEV.**
— *sub-ringens*, Dav. Ool. Mon., vol. i, p. 75, pl. xix, fig. 17. Ool. Sup., vol. iv, p. 205. **JUR.**
— *sub-tetrahedra*, Dav. Ool. Mon., vol. i, p. 95, pl. xvi, figs. 9—12. Ool. Sup., vol. iv, p. 200. **JUR.**
— *sub-variabilis*, Dav. Ool. Mon., vol. i, p. 80, pl. xv, fig. 7, and pl. xviii, fig. 11. Ool. Sup., vol. iv, p. 203. **JUR.**
— *sulcata*, Park. Cret. Mon., vol. i, p. 85, pl. x, figs. 18—20 and 23—36; 21, 22? Cret. Sup., vol. iv, p. 58. **CRET.**
— *Sutherlandi*, Dav. Ool. Sup., vol. iv, p. 190, pl. xxv, figs. 5—8. **JUR.**
— *Tatei*, Dav. Ool. Sup., vol. iv, p. 218, pl. xxviii, fig. 45. **JUR.**
— *tetrahedra*, Sow. Ool. Mon., vol. i, p. 93, pl. xviii, figs. 5—9, not 10; pl. xvi, figs. 13, 14, and p. 96. Ool. Sup., vol. iv, p. 198, pl. xxix, fig. 6. **JUR.**
— — var. *Dumbletonensis*, Dav. Ool. Sup., vol. iv, p. 199, pl. xxix, fig. 5. **JUR.**
— — var. *Northamptonensis*, Dav. Ool. Sup , vol. iv, p. 199, pl. xxix, figs. 7, 12. **JUR.**
— *Thebaulti*, Rouault. Bud.-Salt. Mon., vol. iv, p. 342, pl. xxxviii, figs. 26—29. **DEV.**
— *Thomsoni*, Dav. Sil. Mon., vol. iii, p. 186, pl. xxiv, fig. 18. **SIL.**
— *Thurmani*, Voltz; see RHYNCHONELLA *varians*, var. *Thurmani*.
— ? *trilatera*, de Kon. Carb. Mon., vol. ii, p. 109, pl. xxiv, figs. 23—26. **CARB.**
— *triloba*, Sow. Dev. Mon., vol. iii, p. 64, pl. xii, figs. 1—7. Dev. Sup., vol. v, p. 47, pl. ii, fig. 21. **DEV.**
— *tripartita*, Sow. Sil. Mon., vol. iii, p. 185, pl. xxiv, figs. 15, 16. **SIL.**
— *triplicata*, Quenstedt. Ool. Mon., vol. i, p. 78, pl. xvi, figs. 2, 5 (these figures do not belong to RH. *variabilis*); Ool. Sup., vol. iv, p. 211, pl. xxviii, figs. 35, 36. **JUR.**
— *Upwarensis*, Dav. Cret. Sup., vol. iv, p. 66, pl. viii, figs. 27, 28. **CRET.**
— *Valpyana*, Dav. Bud.-Salt. Mon., vol. iv, p. 343, pl. xxxviii, figs. 33, 34. **DEV.**
— *variabilis*, Schl. Ool. Mon., vol. i, p. 78, pars, pl. xv, figs. 8—10 only. Ool. Sup., vol. iv, p. 208. **JUR.**
— *varians*, Schloth. Ool. Mon., vol. i, p. 83, pl. xvii, figs. 15, 16. Ool. Sup., vol. iv, p. 212, pl. xxviii, figs. 3—12. **JUR.**
— — var. *Smithii*, Walker. Ool. Sup., vol. iv, p. 213, pl. xxviii, figs. 1—3. **JUR.**
— — var. *socialis*, Phillips. Ool. Sup., vol. iv, p. 214, pl. xxviii, figs. 8—11. **JUR.**
— — var. *spathica*, Lamarck. Ool. Sup., vol. iv, p. 214, pl. xxviii, figs. 5—7. **JUR.**
— — var. *Thurmani*, Voltz. Ool. Sup., vol. iv, p. 215, pl. xxviii, figs. 14—16. **JUR.**
— *Vicaryi*, Dav. Bud.-Salt. Mon., vol. iv, p. 343, pl. xxxviii, figs. 30, 31. **DEV.**
— *Walkeri*, Dav. Cret. Sup., vol. iv, p. 68, pl. viii, figs. 33, 34. **CRET.**
— *Weaveri*, Salter. Sil. Mon., vol. iii, p. 185, pl. xxiv, fig. 14. Sil. Sup., vol. v, p. 158, pl. x, fig. 24. **SIL.**
— *Wiestii*, Quenstedt. Cret. Sup., vol. iv, p. 66, pl. viii, fig. 31. **CRET.**
— *Wilsoni*, Sow. Sil. Mon., vol. iii, p. 167, pl. xxiii, figs. 1—9. Sil. Sup., p. 156. **SIL.**
— — var. *Davidsoni*, M'Coy. Sil. Mon., vol. iii, p. 172, pl. xxiii, figs. 11—14. **SIL.**
— — var. *sphæroidalis*, M'Coy. Sil. Mon., vol. iii, p. 173, pl. xxii, fig. 10. **SIL.**
— *Winwoodiana*, Dav. Bud.-Salt. Mon., vol. iv, p. 340, pl. xxxviii, fig. 19. **DEV.**
— *Woodwardii*, Dav.; see RHYNCHONELLA *plicatilis*, var. *octoplicata*.
— *Wrightii*, Dav. Ool. Mon., vol. i, p. 69, pl. xiv, fig. 1; and Appendix to vol. i, p. 21, pl. A, fig. 27. Ool. Sup., vol. iv, p. 188. **JUR.**

Rhynchonella *Vaxleyensis*, Dav. ; see Rhynchonella *concinna*, var. *Vaxleyensis*.
Rhynchopora *Youngii*, Dav. Carb. Mon., vol. ii, p. 286, pl. xxxiii, fig. 11. **CARB.**

Siphonotreta *anglica*, Morris. Sil. Mon., vol. iii, p. 75, pl. viii, fig. 1. **SIL.**
— *micula*, M'Coy. Sil. Mon., vol. iii, p. 76, pl. viii, figs. 2—6. **SIL.**
— *Scotica*, Dav. Sil. Sup., vol. v, p. 217, pl. xvi, figs. 31—33. **SIL.**
Skenidium *areola*, Quenstedt. Dev. Sup., vol. v, p. 49, pl. iii, figs. 11—14. **DEV.**
— *Grayiæ*, Dav. Sil. Sup., vol. v, p. 175, pl. xi, figs. 3—5. **SIL.**
— *Lewisii* (Orthis), Dav. Sil. Mon., vol. iii, p. 208, pl. xxv, figs. 4, 9; and Sil. Sup. vol. v, p. 173. **SIL.**
— ? — var. *Hughesi* (Orthis), Dav. Sil. Mon., vol. iii, p. 254, pl. xxxviii, fig. 26. Sil. Sup., vol. v, p. 174. **SIL.**
— — var. *Woodlandiense*, Dav. Sil. Sup., vol. v, p. 174, pl. xi, figs. 1, 2. **SIL.**
— ? *Shallockiense*, Dav. Sil. Sup., vol. v, p. 174, pl. xi, figs. 6, 7. **SIL.**
Spirifera *acuta*, Martin. Carb. Mon., vol. ii, p. 224, pl. lii, figs. 6, 7. **CARB.**
— *alata*, Schl. Perm. Mon., vol. ii, p. 13, pl. i, figs. 23—36; and pl. ii, figs. 6, 7. **PERM.**
— *apertura*, Schl. ; see Spirifera *canalifera*.
— *bijugata*, M'Coy. Sil. Mon., vol. iii, p. 89, pl. x, figs. 1—3. **SIL.**
— *bisulcata*, Sow. ; see Spirifera *trigonalis*, var. *bisulcata*.
— *canalifera*, Val. = *aperturata*, Schl. Dev. Mon., vol. iii, p. 26, pl. vi, fig. 9. **DEV.**
— (Martinia) *Carlukensis*, Dav. Carb. Mon., vol. ii, p. 59, pl. xiii, fig. 14; and pl. lv, figs. 14, 15. **CARB.**
— *Clannyana*, King. Perm. Mon., vol. ii, p. 15, pl. i, figs. 47—49. Perm. Sup., vol. v, p. 15, pl. i, figs. 47—49. **PERM.**
— *convoluta*, Phillips. Carb. Mon., vol. ii, p. 35, pl. v, figs. 9—15 (not figs. 2—8), p. 223, pl. l, figs. 1, 2. **CARB.**
— *crassa*, De Kon. ; see Spirifera *trigonalis*, var. *bisulcata*.
— *crispa*, Hisinger. Sil. Mon., vol. iii, p. 97, pl. x, figs. 13—15. Sil. Sup., vol. v, pl. iv, figs. 9, 10. **SIL.**
— *cultrijugata*, Roemer ; see Spirifera *primæva*.
— *curvata*, Schl. Dev. Mon., vol. iii, p. 39, pl. iv, figs. 29—32, 33? 34?; pl. ix, figs. 26, 27. Dev. Sup., vol. v, p. 32, pl. i, fig. 34, and pl. ii, fig. 4. **DEV.**
— *duplicicosta*, Phillips. Carb. Mon., vol. ii, pp. 24, 221, pl. iii, figs. 7—10; pl. iv, figs. 3, 5—11; pl. v, figs. 35—37, incorrectly referred to Sp. *trigonalis*. **CARB.**
— *elevata*, Dalman. Sil. Mon., vol. iii, p. 95, pl. x, figs. 7—11. **SIL.**
— *globosa*, Salter ; see Spirifera *plicatella*, var. *globosa*.
— *grandicostata*, M'Coy. Carb. Mon., vol. ii, p. 33, pl. v, figs. 38, 39; pl. vii, figs. 7—16 (probably also a var. of *Sp. bisulcata*). **CARB.**
— (Martinia) *glabra*, Martin. Carb. Mon., vol. ii, p. 59, pl. xi, figs. 1—9; pl. xii, figs. 1—5, 11, 12, p. 225. Carb. Sup., vol. iv, p. 274, pl. xxxii, figs. 3—5. **CARB.—DEV.**
— *humerosa*, Phillips. Carb. Mon., vol. ii, p. 23, pl. iv, figs. 15, 16. **CARB.**
— *hysterica*, Schl. Dev. Mon., vol. iii, p. 34, pl. viii, figs. 16, 17. **DEV.**
— *integricostata*, Phillips. Carb. Mon., vol. ii, p. 55, pl. ix, figs. 13, 19. **CARB.**
— *interlineata*, Sow. ; see Spirifera *plicatella*, var. *interlineata*.
— *lævicosta*, var.=*ostiolata*, Schl. Dev. Mon., vol. iii, p. 28, pl. viii, figs. 4, 5. Dev. Sup., vol. v, p. 33, pl. ii, figs. 2, 3. **DEV.**
— *megaloba?* Phil. Dev. Mon., p. 28, pl. ix, fig. 23. **DEV.**

SPIRIFERA *mesogonia*, M'Coy. Carb. Mon., vol. ii, p. 48, pl. vii, fig. 24. **CARB.**
— *mesomala?* Phil. Dev. Mon., vol. iii, p. 27, pl. vi, fig. 8. **DEV.**
— *minima*, Sow. Carb. Mon., vol. ii, p. 40, pl. vii, figs. 56—59. **CARB.**
— *Newtoniensis*, Dav. Dev. Mon. vol. iii, p. 40, pl. ix, fig. 21. **DEV.**
— *nuda*, Sow. Dev. Mon., vol. iii, p. 38, pl. iv, figs 17—24. **DEV.**
— *obliterata?* Phil. Dev. Mon., vol. iii, p. 27, pl. vi, fig. 10. **DEV.**
— *ostiolata*, Schl.; see SPIRIFERA *lævicosta*.
— *planata*, Phil. Carb. Mon., vol. ii, p. 26, pl. vii, figs. 25—36. **CARB.**
— *plicatella*, var. *radiata*, Sow. Sil. Mon., vol. iii, pp. 84—87, pl. ix, figs. 1—6. Sil. Sup., vol. v, p. 137, pl. vi, figs. 11, 12; and pl. viii, figs. 2, 3. **SIL.**
— — var. *interlineata*, Sow. Sil. Mon. (part as SP. *plicatella*), vol. iii, p. 84, pl. ix, figs. 9—12. **SIL.**
— — var. *globosa*, Salter. Sil. Mon., vol. iii, p. 89, pl. ix, figs. 7, 8. **SIL.**
— *primæva*, Steininger. Under the incorrect name of SP. *cultrijugata*, Roemer, in Dev. Mon., vol. iii, p. 35, pl. viii, figs. 1—3. Dev. Sup., p. 34. **DEV.**
— *pinguis*, Sow. Carb. Mon., vol. ii, p. 50, pl. x, figs. 1—12. Carb. Sup., vol. iv, p. 274, pl. xxxi and xxxii, including SP. *rotundata*, Sow., which is the full-grown condition of SP. *pinguis*. **CARB.**
— *radiata*, Sow.; see SPIRIFERA *plicatella*, var. *radiata*.
— *Reedii*, Dav. Carb. Mon., vol. ii, p. 43, pl. v, figs. 40—47 (doubtful species). **CARB**
— *rhomboidea*, Phillips. Carb. Mon., vol. ii, footnote, p. 36; p. 223, pl. v, figs. 2—8. **CARB.**
— (MARTINIA ?) *rhomboidalis*, M'Coy. Carb. Mon., vol. ii, p. 57, pl. xii, figs. 6, 7 (is a variety of SP. *glabra*). **CARB.**
— *rotundata*, Sow.; see SPIRIFERA *pinguis*.
— *rudis?* Phil. Dev. Mon., vol. iii, p. 28, pl. ix, figs. 24, 25. **DEV.**
— *simplex*, Phil. Dev. Mon., vol. iii, p. 46, pl. vi, figs. 18—22. **DEV.**
— *speciosa*, Schl. Dev. Mon., vol. iii, p. 29, pl. viii, figs. 6—8. Bud.-Salt. Mon., vol. iv, p. 340, pl. xxxviii, figs. 15—18. **DEV.**
striata, Martin. Carb. Mon., vol. ii, pp. 19, 221, pl. ii, figs. 12—21; pl. iii, figs. 2—6; and Carb. Sup., vol. iv, p. 274, pl. xxxi, xxxii, and xxxiv; also under the mistaken name of SP. *Mosquensis*. Carb. Mon., vol. ii, p. 22, pl. iv, figs. 13, 14, and Carb. Sup., vol. iv, p. 274 (not SP. *Mosquensis*, Fischer, a species that does not occur in Great Britain), as subsequently found to be the case by Prof. L. De Koninck. **CARB.**
— *subcuspidata*, Schnur. Dev. Mon., vol. iii, p. 33, pl. viii, figs. 14, 15. **DEV.**
— *sulcata*, Hisinger. Sil. Mon., vol. iii, p. 91, pl. x, figs. 4—6. **SIL.**
— *transiens*, M'Coy. Carb. Mon., vol. ii, p. 33, pl. iv, fig. 2 (probably a var. of SP. *bisulcata*). **CARB.**
— *triangularis*, Martin. Carb. Mon., vol. ii, p. 27, pl. v, figs. 16—24, p. 223; pl. l, figs. 10—18. **CARB.**
— *trigonalis*, Martin. Carb. Mon., vol. ii, p. 29, pl. v, figs. 25—34, 35—37? p. 222, pl. l, figs. 3—9; and Carb. Sup., vol. iv, p. 276, pl. xxxiv, figs. 2—5. **CARB.**
— — var. *bisulcata*, Sow. Carb. Mon., vol. ii, p. 31, pl. iv, fig. 1? pl. v, fig. 1; pl. vi, figs. 1—19; pl. vii, fig. 4. (It is only a variety of SP. *trigonalis*.) **CARB.**
— — var. *crassa*, De Kon. Carb. Mon., vol. ii, p. 25, pl. vi, figs. 20, 22; and pl. vii, figs. 1—3, is a var. of SP. *trigonalis*, var. *bisulcata*. **CARB.**
— *triradialis*, Phil. Carb. Mon., vol. ii, p. 49, pl. ix, figs. 4—12. **CARB.**
— *undifera*, F. Roemer. Dev. Mon., vol. iii, p. 36, pl. vii, figs. 1—10. Dev. Sup., vol. v, p. 33, pl. i, fig. 33. **DEV.**

SPIRIFERA *undifera*, var. *undulata*, F. Roemer. Dev. Mon., vol. iii, p. 37, pl. viii, figs. 11—14. **DEV.**

— *undulata*, F. Roemer; see SPIRIFERA *undifera*, var. *undulata*.

— (MARTINIA) *Urii*, Fleming. Carb. Mon., vol. ii, p. 58, pl. xii, figs. 13, 14. Dev. Mon., vol. iii, p. 41, pl. iv, figs. 25—28. Dev. Sup., vol. v, p. 34. **CARB.—DEV.**

— *Verneuilii*, Murch. (as SP. *disjuncta*, Sow.). Dev. Mon., vol. iii, p. 23, pl. v, figs. 1—12; pl. vi, figs. 1—5; and Dev. Sup., vol. v, p. 35, pl. ii, fig. 1. Bud.-Salt. Mon., vol. iv, p. 339, pl. xxxviii, figs. 9—14. **DEV.**

SPIRIFERINA *adscendens*, E. Desl. Ool. Sup., vol. iv, p. 227, pl. xxix, fig. 20 (not British, is French). **JUR.**

— *cristata*, Schl. Perm. Mon., vol. ii, pp. 17, 226, pl. i, figs. 37—40, 45, 46; pl. ii, figs. 43—45; pl. lii, figs. 9, 10, 13. Dev. Mon., vol. iii, p. 46, pl. vi, figs. 11—15. **PERM.—DEV.**

— — var. *octoplicata*, Dav. Carb. Mon., vol. ii, p. 38, pl. vii, figs. 37—47, 60 and 61; p. 226, pl. lii, figs. 9, 10, 13. Dev. Mon., vol. iii, p. 123. Bud.-Salt. Mon., vol. iv, p. 340, pl. xxxviii, figs. 7, 8. **CARB.—DEV.**

— *Deslongchampsii*, Dav. Ool. Sup. vol. iv, p. 101, pl. xi, fig. 12. **JUR.**

— *Etheridgei*, Dav. Carb. Sup., vol. iv, p. 278. **CARB.**

— *Hartmanni*, Zeiten. Ool. Mon., vol. ii, p. 22, pl. ii, figs. 10—12; and Ool. Sup., vol. iv, p. 95, pl. xi, fig. 7. **JUR.**

— *Ilminsteriensis*, Dav. Ool. Mon., vol. i, p. 24, pl. iii, fig. 7. Ool. Sup., vol. iv, p. 101. **JUR.**

— *insculpta*, Phillips. Carb. Mon., vol. ii, p. 42, pl. vii, figs. 48—55. Carb. Sup., vol. iv, pl. lii, figs. 14, 15. Dev. Sup., vol. v, pl. i, fig. 32. **CARB.—DEV.**

— *laminosa*, M'Coy. Carb. Mon., vol. ii, p. 36, pl. vii, figs. 17—22. Carb. Sup., vol. v, p. 277. **CARB.**

— ? *minima*, Moore. Ool. Sup., vol. iv, p. 103, pl. xi, fig. 17. **JUR.**

— ? *Moorei*, Dav. Ool. Sup., vol. iv, p. 103, pl. xiii, fig. 20. **JUR.**

— *Münsteri*, Dav. Ool. Mon., vol. i, p. 26, pl. iii, figs. 4—6. Ool. Sup., vol. iv, p. 101. **JUR.**

— *multiplicata*, Sow. Perm. Mon., vol. ii, p. 19, pl. i, figs. 41—44. **PERM.**

— *octoplicata*, Dav.; see SPIRIFERA *cristata*, var. *octoplicata*.

— ? *oolitica*, Moore. Appendix to vol. i, p. 30; and Ool. Sup., vol. iv, p. 102, pl. xi, figs. 13—15. **JUR.**

— *oxygona*, E. Desl. Ool. Sup., vol. iv, p. 100, pl. xi, figs. 1—5. **JUR.**

— *oxyptera*, Bouvigner. Ool. Sup., vol. iv, p. 99, pl. x, figs. 31, 32. **JUR.**

— *partita*, Portlock. Carb. Mon., vol. ii, p. 41, pl. vii, figs. 60, 61 (is a syn. of SP. *octoplicata*). **CARB.**

— *pinguis*, Zeiten (not Sow.). Ool. Mon. (pars), vol. i, p. 20, pl. ii, figs. 7—9. Ool. Sup., vol. iv, p. 96, pl. xi, fig. 8. **JUR.**

— *rostrata*, Schl. (pars) Ool. Mon., vol. i, p. 20, pl. ii, figs. 1—6 and 13—21 (not 7—12, or pl. iii, fig. 1). Ool. Sup., vol. iv, p. 95, pl. ix, fig. 6. **JUR.**

— *Signiensis*, Buv.? Ool. Sup., vol. iv, p. 99, pl. xi, fig. 11. **JUR.**

— *Tessoni*, var.? Ool. Sup., vol. iv, p. 228, pl. xxix, fig. 21 (not British, is French). **JUR.**

— *verrucosa*, v. Buch. Ool. Mon., vol. i (pars), p. 20, pl. iii, fig. 1. Ool. Sup., vol. iv, p. 97, pl. xi, figs. 9, 10. **JUR.**

— *Walcotti*, Sow. Ool. Mon., vol. i, p. 25, pl. iii, figs. 2, 3. Ool. Sup., vol. iv, p. 98. **JUR.**

STREPTIS *Grayii*, Dav. (as ATRYPA?). Sil. Mon., vol. iii, p. 141, pl. xiii, figs. 14—22. Sil. Sup., vol. v, p. 139. **SIL.**

STREPTORHYNCHUS *arachnoideus*, Phillips; see STREPTORHYNCHUS *crenistria*, var. *arachnoideus*.
— *crenistria*, Phillips. Carb. Mon., vol. ii, pp. 124, 228, pl. xxvi, figs. 1—6; pl. xxvii, figs. 1—5, and 10? Carb. Sup., vol. iv, p. 288, pl. xxxvii, figs. 1—5; and Bud.-Salt. Mon., vol. iv, p. 351, pl. xxxix, fig. 3. **CARB.—DEV.**
— — var. *arachnoideus*, Phillips. Carb. Mon., vol. ii, p. 127, pl. xxv, figs. 19—21; pl. xxvi, figs. 2—4 (lower figures), 5, 6. Dev. Mon., vol. iii, p. 81, pl. xviii, figs. 4, 7. **CARB.—DEV.**
— — var. *Kellii*, M'Coy. Carb. Mon., vol. ii, p. 127, pl. xxvii, fig. 8. **CARB.**
— — var. *cylindricus*, M'Coy. Carb. Mon., vol. ii, p. 128, pl. xxvii, fig. 9. Carb. Sup., vol. iv, p. 290, pl. xxxvii, figs. 6, 7. **CARB.**
— — var. *radialis*, Phil. Carb. Mon., vol. ii, p. 129, pl. xxv, figs. 16—18. **CARB.**
— — var. *senilis*, Phillips. Carb. Mon., vol. ii, pl. xxvii, figs. 2—10; and Carb. Sup., vol. iv, p. 290. **CARB.**
— *cylindricus*, M'Coy; see STREPTORHYNCHUS *crenistria*, var. *cylindricus*.
— *gigas*, M'Coy. Dev. Mon., vol. iii, p. 83, pl. xvi, figs. 1—3. **DEV.**
— *Kellii*, M'Coy; see STREPTORHYNCHUS *crenistria*, var. *Kellii*.
— *nasutus*, Lindström (as CYRTIA?). Sil. Mon., vol. iii, p. 201, pl. xxv, figs. 1, 2. Sil. Sup., vol. v, p. 172. **SIL.**
— *pelargonatus*, Schl. Perm. Mon., vol. ii, p. 32, pl. ii, figs. 33—42. Perm. Sup., vol. iv, pl. xxx, fig. 3. **PERM.**
— ? *persarmentosus*, M'Coy. Dev. Mon., vol. iii, p. 84, pl. xvi, fig. 5. **DEV.**
— *radialis*, Phil.; see STREPTORHYNCHUS *crenistria*, var. *radialis*.
— *senilis*, Phil.; see STREPTORHYNCHUS *crenistria*, var. *senilis*.
— *umbraculum*, Schl. Dev. Mon., vol. iii, p. 76, pl. xvi, fig. 6; and pl. xviii, figs. 1—5. Dev. Sup., vol. v, pl. iii, fig. 20. **DEV.**
STRICKLANDINIA? *Balcletchiensis*, Dav. Sil. Sup., vol. v, p. 166, pl. ix, figs. 27—29. **SIL.**
— *lens*, Sow. Sil. Mon., vol. iii, p. 161, pl. xix, figs. 13—23. Sil. Sup., vol. v, p. 165, pl. ix, figs. 2—5. **SIL.**
— *lirata*, Sow. Sil. Mon., vol. iii, p. 159, pl. xx, figs. 1—13. Sil. Sup., vol. v, p. 165, pl. ix, fig. 1. **SIL.**
STRINGOCEPHALUS *Burtini*, Def. Dev. Mon., vol. iii, p. 11, pl. i, figs. 18—22; pl. ii, figs. 1—11. Dev. Sup., vol. v, p. 19, pl. iii, figs. 2, 3. **DEV.**
STROPHALOSIA *Goldfussi*, Münster. Perm. Mon., vol. ii, p. 39, pl. iii, figs. 1—10. Carb. Mon., vol. ii, p. 269. **PERM.**
— — var. *Lewisiana*, de Kon. Perm. Mon., vol. ii, p. 43, pl. iii, figs. 19—22. Carb. Mon., pl. liv, fig. 43. **PERM.**
— *lamellosa*, Geinitz. Perm. Mon., vol. ii, p. 44, pl. iii, figs. 24—41. Carb. Mon., vol. ii, p. 269. **PERM.**
— *Lewisiana*, de Kon.; see STROPHALOSIA *Goldfussi*, var. *Lewisiana*.
— *productoides*, Murchison. Dev. Mon., vol. iii, p. 97, pl. xix, figs. 13—21. **DEV.**
STROPHOMENA *antiquata*, Sow. Sil. Mon., vol. iii, p. 299, pl. xliv, figs. 2—13 and 21, 22. Sil. Sup., vol. v, p. 193, pl. xv, figs. 12—14. **SIL.**
— *applanata*, Salter. Sil. Mon., vol. iii, p. 308, pl. xliii, figs. 12—14. **SIL.**
— *arenacea*, Salter. Sil. Mon., vol. iii, p. 296, pl. xlii, figs. 6—8. Sil. Sup., vol. v, p. 197, pl. xvi, figs. 2—5. **SIL.**
— ? *bipartita*, Salter. Sil. Sup., vol. v, p. 193, pl. xvi, figs. 9—12. **SIL.**
— *Budleighensis*, Dav. Bud.-Salt. Mon., vol. iv, p. 349, pl. xxxix, fig. 4. **DEV.**
— *Callawayiana*, Dav. Sil. Sup., vol. v, p. 193, pl. xvi, figs. 6, 7. **SIL.**

STROPHOMENA *compressa*, Sow. Sil. Mon., vol. iii, p. 315, pl. xlvi, figs. 7—10. **SIL.**

— *corrugatella*, Dav. Sil. Mon., vol. iii, p. 301, pl. xli, figs. 8—14. Sil. Sup., vol. v, p. 192, pl. xv, figs. 23—26. **SIL.**

— *Dayi*, Dav. Sil. Mon., vol. iii, p. 292, pl. xli, fig. 7. **SIL.**

— *deltoidea*, Conrad. Sil. Mon., vol. iii, p. 292, pl. xlii, figs. 1—5, pl. xxxix, fig. 22. Sil. Sup., vol. v, p. 197, pl. xv, figs. 16—22. **SIL.**

— — var. *undata*, M'Coy. Sil. Mon., vol. iii, p. 295, pl. xxxix, figs. 23, 24. **SIL.**

— *Edgelliana*, Dav. Bud.-Salt. Mon., vol. iv, p. 349, pl. xxxix, figs. 5—7. **DEV.**

— *Etheridgei*, Dav. Bud.-Salt. Mon., vol. iv, p. 350, pl. xxxix, figs. 10, 11. **DEV.**

— *euglypha*, Hisinger. Sil. Mon., vol. iii, p. 288, pl. xl, figs. 1—5. **SIL.**

— *expansa*, Sow. Sil. Mon., vol. iii, p. 312, pl. xlv, figs. 1—10. Sil. Sup., vol. v, p. 194, pl. xv, figs. 1—5. **SIL.**

— *filosa*, Dav. Sil. Mon., vol. iii, p. 307, pl. xliv, figs. 14—20. **SIL.**

— *Fletcheri*, Dav. Sil. Mon., vol. iii, p. 317, pl. xlvii, figs. 5, 6. **SIL.**

— *funiculata*, M'Coy. Sil. Mon., vol. iii, p. 290, pl. xl, figs. 9—13. **SIL.**

— *grandis*, Sow. Sil. Mon., vol. iii, p. 311, pl. xlvi, figs. 1—3, and 5, 6. Sil. Sup., vol. v, p. 195, pl. xv, fig. 6. **SIL.**

— *Hendersoni*, Dav. Sil. Mon., vol. iii, p. 311, pl. xliii, fig. 15. **SIL.**

— *Hollii*, Dav. Sil. Mon., vol. iii, p. 303, pl. xlii, figs. 18, 19. **SIL.**

— *imbrex*, Pander, var. *semiglobosa*, Dav. Sil. Mon., vol. iii, p. 286, pl. xli, figs. 1—6. Sil. Sup., vol. v, p. 195, pl. xv, figs. 9—11. **SIL.**

— *Jukesii*, Dav. Sil. Mon., vol. iii, p. 296, pl. xxxvii, figs. 23—26. **SIL.**

— *Llandeiloensis*, Dav. Sil. Mon., vol. iii, p. 316, pl. xlvi, figs. 11—14. **SIL.**

— *nodulosa*, Phil.; see STROPHOMENA *rhomboidalis*, var. *nodulosa*.

— *Orbignyi*, Dav. Sil. Mon., vol. iii, p. 306, pl. xlii, figs. 12—14. **SIL.**

— *ornatella*, Salter. Sil. Mon., vol. iii, p. 309, pl. xliii, figs. 16—20. **SIL.**

— *pecten*, Linné. Sil. Mon., vol. iii, p. 304, pl. xliii, figs. 1—11. Sil. Sup., vol. v, p. 194, pl. xv, fig. 15. **SIL.**

— *retroflexa*, Salter. Sil. Mon., vol. iii, p. 298, pl. xlii, figs. 15—17. Sil. Sup., vol. v, p. 195, pl. xv, figs. 7, 8. **SIL.**

— *rhomboidalis*, Wilckens (as St. *analoga*), Phillips. Carb. Mon., vol. ii, p. 119, pl. xxviii, figs. 1—13. Carb. Sup., vol. iv, p. 291, pl. xxxvi, fig. 23. Dev. Mon., vol. iii, p. 76, pl. xv, figs. 15—17. Sil. Mon., vol. iii, p. 281, pl. xxxix, figs. 1—21; pl. xliv, fig. 1. Sil. Sup., vol. v, p. 192. **CARB.—SIL.**

— — var. *nodulosa*, Phillips. Dev. Sup., vol. v, p. 52, pl. iii, fig. 15. **DEV.**

— *Rouaulti*, Dav. Bud.-Salt. Mon., vol. iv, p. 348, pl. xxxix, fig. 9. **DEV.**

— *semiglobosa*, Dav.; see STROPHOMENA *imbrex*, var. *semiglobosa*.

— *Shallockiensis*, Dav. Sil. Sup., vol. v, p. 192, pl. xi, figs. 20, 21, pl. xii, fig. 30; and pl. xvi, fig. 8. **SIL.**

— *Siluriana*, Dav. Sil. Mon., vol. iii, p. 303, pl. xlvii, figs. 1—4. **SIL.**

— *simulans*, M'Coy. Sil. Mon., vol. iii, p. 297, pl. xlii, figs. 9, 10. **SIL.**

— *undata*, M'Coy; see STROPHOMENA *deltoidea*, var. *undata*.

— *ungula*, M'Coy. Sil. Mon., vol. iii, p. 285, pl. xlii, figs. 20, 21. **SIL.**

— *Vicaryi*, Dav. Bud.-Salt. Mon., vol. iv, p. 348, pl. xxxix, fig. 8. **DEV.**

— *Walmstedti*, Lindström. Sil. Mon., vol. iii, p. 290, pl. xl, figs. 6—8. **SIL.**

— *Waltoni*, Dav. Sil. Mon., vol. iii, p. 310, pl. xlii, fig. 11. Sil. Sup., vol. v, p. 195. **SIL.**

SYRINGOTHYRIS *bicarinata*, M'Coy. Carb. Mon., vol. ii, p. 47, pl. viii, fig. 18 (it seems to be a synonym of SYRINGOTHYRIS *distans*). **CARB.**

Syringothyris *cuspidata*, Martin (under genus of Spirifera). Carb. Mon., vol. ii, pp. 44, 224, pl. viii, figs. 19—24; and pl. lii, fig. 3; pl. ix, figs. 1, 2. Carb. Sup., vol. iv, p. 278, pl. xxxii, fig. 16; and pl. xxxiii, figs. 1—3. **CARB.**

— *distans*, Sow. Carb. Mon., vol. ii, p. 46, pl. viii, figs. 1—17; p. 224. Carb. Sup., vol. iv, p. 281, pl. xxxiii, figs. 4, 5. **CARB.**

— *sub-conica*, Martin. Carb. Mon., vol. ii, p. 48, pl. ix, fig. 3; pl. lii, fig. 4. Carb. Sup., vol. vi, p. 281, pl. xxxii, fig. 17. **CARB.**

Terebratella *Buckmani*, Moore. Ool Sup., vol. iv, p. 114, pl. xiv, figs. 13, 14. **JUR.**

— *Davidsoni*, Walker. Cret. Sup., vol. iv, p. 27, pl. viii, figs. 1—7. **CRET.**

— *Fittoni*, Mëyer. Cret. Sup., vol. iv, p. 26, pl. viii, figs. 8—13. **CRET.**

— *furcata*, Sow. Ool. Mon., vol. iv, p. 115, pl. xiv, figs. 15, 16. **JUR.**

— *Keepingii*, Walker. Appendix to Sup., vol. v, p. 245, pl. xviii, figs. 4, 5. **CRET.**

— ? *liasiana*, Desl. Ool. Sup. vol. iv, p. 116. **JUR.**

— *Menardi*, Lam. Cret. Mon., vol. i, p. 24, pl. iii, figs. 34—42; and Cret. Sup., vol. iv, p. 24, pl. viii, fig. 14. Appendix to Sup., vol. v, p. 247, pl. xviii, fig. 6. **CRET.**

— *Moorei*, Dav. Ool. Sup., vol. iv, p. 115, pl. xiv, fig. 17. **JUR.**

— *oblonga*, Sow. Cret. Mon., vol. i, p. 51, pl. ii, figs. 29—32. Sup., vol. iv, p. 26. **CRET.**

— *pectita*, Sow. Cret. Mon., vol. i, p. 26, pl. iii, figs. 29—33. Cret. Sup., vol. iv, p. 25. **CRET.**

— *trifida*, Mëyer. Cret. Sup., vol. iv, p. 25, pl. viii, figs. 15—17. **CRET.**

— *truncata*, Sow. Cret. Mon., vol. i, p. 25, pl. iii, figs. 34—41. Cret. Sup., vol. iv, p. 25. **CRET.**

Terebratula *abrupta*, Tate. Cret. Sup., vol. iv, p. 17, pl. ii, fig. 17. **CRET.**

— *ampla*, Buckman; see Terebratula *perovalis*, var. *ampla*.

— *Anglica*, Oppel (see Wald. *Anglica*). Ool. Mon., Appendix to, vol. i, pl. A, figs. 10—13. Ool. Sup., vol. iv, p. 135, pl. xxiii, figs. 23—26; and Appendix to Supplements, vol. v, pl. xx, fig. 15. **JUR.**

— *arcuata*, A. Roemer (as Ter. *rugulosa*, Morris). Cret. Mon., vol. i, p. 49, pl. iv, fig. 14, and Cret. Sup., vol. iv, p. 32, pl. ii, fig. 16. **CRET.**

— *Bentleyi*, Dav. Ool. Mon., vol. i, p. 58, pl. xiii, figs. 9, 10, 11; and Appendix to vol. iv, p. 19. Ool. Sup., vol. iv, p. 141. **JUR.**

— *biplicata*, Sow. Cret. Mon., vol. i, p. 55, pl. vi, figs. 1—42 (only). Cret. Sup., vol. iv, p. 33, pl. v, figs. 1, 2. **CRET.**

— *Birdlipiensis*, Walker; see Terebratula *globata*, var. *Birdlipiensis*.

— *bisinuata*, Lamarck. Tert. Mon., vol. i, p. 19; pl. i, fig. 17 (?). Appendix to vol. i, pl. A, fig. 2. Ter. Sup., vol. iv, p. 14. **TER.**

— *bisuffarcinata*, Zeiten (not Schlotheim?). Ool. Sup., vol. iv, p. 124, pl. xv, figs. 1—3. **JUR.**

— *Boloniensis*, Sauvage et Rigaux. Ool. Sup., vol. iv, p. 154, pl. xix, figs. 1, 2. Appendix to Sup., vol. v, p. 256, pl. xviii, fig. 19. **JUR.**

— *Bradfordiensis*, Walker. Ool. Sup., vol. iv, p. 150, pl. xvii, fig. 6. **JUR.**

— *Brickhillensis*, W. Keeping; see Terebratula *Moutoniana*, var. *Brickhillensis*.

— *Buckmani*, Dav. Ool. Mon., vol. i, p. 44, pl. vii, figs. 15, 16. **JUR.**

— — var. *Buckmaniana*, Walker. Ool. Sup., vol. iv, p. 156, pl. xix, figs. 14—17. **JUR.**

— *bullata*, Sow. (see Waldheimia *bullata*). Ool. Mon., vol. i, pl. xi, fig. 19 (only). Ool. Sup., vol. iv, p. 138, pl. xvii, fig. 5; pl. xxi, figs. 21, 22. **JUR.**

— *Cantabrigensis*, Walker; see Terebratula *depressa*, var. *Cantabrigensis*.

TEREBRATULA *capillata*, d'Archiac. Cret. Mon., vol. i, p. 46, pl. v, fig. 12. Cret. Sup., vol. iv, p. 33, pl. vii, fig. 2. **CRET.**

— *carnea*, Sow. Cret. Mon., vol. i, p. 67, pl. viii, figs. 1—4. Cret. Sup., vol. iv, p. 47. **CRET.**

— *coarctata*, Park. Ool. Mon., vol. i, p. 59, pl. xii, figs. 12—15; and Ool. Sup., vol. iv, p. 143, pl. xiv, figs. 18, 19. **JUR.**

— — var. *reticulata*, Sow. Ool. Sup. vol. iv, p. 144, pl. xiv, figs. 20, 21, and pl. xxv, fig. 3. **JUR.**

— *Cortonensis*, S. Buck. Appendix to Sup., vol. v, p. 259, pl. xix, fig. 3. **JUR.**

— *Craneæ*, Dav. Ool. Sup., vol. iv, p. 151, pl. xx, figs. 1, 2. Appendix to Sup., vol. v, p. 257. **JUR.**

— *curviconcha*, Oppel. Appendix to Sup., vol. v, p. 256, pl. xviii, fig. 15. **JUR.**

— *curvifrons*, Oppel. (as W. *carinata*). Ool. Mon., vol. i, p. 35, pl. iv, figs. 15, 16. Appendix to vol. i, pl. A, fig. 17. Ool. Sup., vol. iv, p. 153, pl. xxiv, fig. 33; and Appendix to Sup., vol. v, p. 264, pl. xx, fig. 17. **JUR.**

— *cyrta*, Walker; see TEREBRATULA *depressa*, var. *cyrta*.

— *Dallasi*, Walker. Cret. Sup., vol. iv, p. 45, pl. iii, figs. 1—5. **CRET.**

— *decipiens*, E. Desl. (as T. *sphæroidalis*). Ool., vol. i, pl. xi, figs. 16—18; and Ool. Sup., vol. iv, p. 151, pl. xx, figs. 4—8. **JUR.**

— *depressa*, Lamarck. Cret. Mon., vol. i, p. 70, pl. ix, figs. 9—24. Cret. Sup., vol. iv, p. 40, pl. iv, figs. 1—4. Appendix to Sup., vol. v, pl. xviii, fig. 7. **CRET.**

— — var. *Cantabrigensis*, Walker. Cret. Sup., vol. iv, p. 41, pl. iv, figs. 8—10. **CRET.**

— — var. *cyrta*, Walker. Cret Sup., vol. iv, p. 41, pl. iv, figs. 6, 7. **CRET.**

— — var. *uniplicata*, Walker. Cret. Sup., vol. iv, p. 40, pl. iv, figs. 2 and 5. **CRET.**

— *Edwardsii*, Dav.; see TEREBRATULA *punctata*, var. *Edwardsii*.

— *Endesei*, Oppel. Ool. Mon. (as T. *globata*), vol. i, pl. xiii, fig. 4, and Ool. Sup., vol. iv, p. 138, pl. xvii, fig. 4. **JUR.**

— *Etheridgei*, Dav. Appendix to vol. i, p. 20, pl. A, figs. 7, 8. **JUR.**

— *Eudesiana*, S. Buckman. Appendix to Sup., vol. v, p. 255, pl. xviii, fig. 18. **JUR.**

— *extensa*, Meyer. Cret. Sup., vol. iv, p. 43, pl. v, figs. 22—24. **CRET.**

— *Ferryi*, E. Desl. Appendix to Sup., vol. v, p. 257, pl. xviii, figs. 20, 21 (not Ool. Sup., vol. iv, p. 139, pl. xvii, figs. 7, 8, which is T. *Hollandæ*, Buckman). **JUR.**

— *ficus*, M'Coy; see DIELASMA *hastata*, var. *ficus*.

— *Fileyensis*, Walker. Ool. Sup., vol. iv, p. 139, pl. xiv, figs. 22—24. **JUR.**

— *fimbria*, Sow. Ool. Mon., vol. i, p. 61, pl. xii, figs. 6—12. Ool. Sup., vol. iv, p. 141, pl. xx, fig. 3. **JUR.**

— *flabellum*, Desl. Ool. Mon., vol. i, p. 62, pl. xii, figs. 19—21. **JUR.**

— *Fleischeri*, Oppel.; see TEREBRATULA *globata*, var. *Fleischeri*.

— *galeiformis*, M'Coy (T. *sub-Bentleyi*, Dav.). Ool. Mon., vol. i, p. 59, pl. xiii, fig. 11, and Appendix to vol. i, p. 19, pl. A, fig. 15. **JUR.**

— *genuina*, King; see DIELASMA *elongata*, var. *genuina*.

— *Gesneri*, Étalon? Ool. Sup., vol. iv, p. 155, pl. xix, figs. 4, 5. **JUR.**

— *Gillingensis*, Dav.; see DIELASMA *Gillingensis*.

— *globata*, Sow. Ool. Mon., vol. i, p. 54, pl. xiii, figs. 2, 3 (Sowerby's types), 4?, 5, 6, 7? Ool. Sup., vol. iv, pp. 135, 149, pl. xvii, figs. 1—3. **JUR.**

— — var. *Birdlipiensis*, Walker. Ool. Sup., vol. iv, p. 150, pl. xvii, figs. 18—21. **JUR.**

— — var. *Fleischeri*, Oppel. Ool. Mon., vol. i, pl. xiii, fig. 7. Appendix to vol. i, pl. A, fig. 18; and Ool. Sup., vol. iv, 137, pl. xvii, fig. 2, probably 1 likewise. **JUR.**

TEREBRATULA *globulina*, Dav. Ool. Mon., vol. i, p. 57, pl. xi, figs. 20, 21. Ool. Sup., vol. iv, p. 135. **JUR.**

— *grandis*, Blum. Tert. Mon., vol. i, p. 16, pl. i, fig. 18; pl. ii, figs. 1—8. Tert. Sup., vol. iv, p. 15, pl. ii, figs. 1—4. **TER.**

— *gravida*, Szajnocha. Appendix to Sup., vol. v, p. 261, pl. xviii, fig. 17. **JUR.**

— *Haresfieldensis*, Dav.; see TEREBRATULA *punctata*, var. *Haresfieldensis*.

— *hastala*, Sow.; see DIELASMA *hastala*.

— *hemisphærica*, Sow. Ool. Mon., vol. i, p. 64, pl. xiii, figs. 17, 18. Ool. Sup., vol. iv, p. 142. **JUR.**

— *Hibernica*, Tate; see TEREBRATULA *semiglobosa*, var. *Hibernica*.

— *Hollandæ*, S. Buckman (under the incorrect name of *T. Ferryi*). Ool. Sup., vol. iv, p. 139, pl. xvii, figs. 7, 8. Appendix to Sup., vol. v, p. 258, pl. xviii, fig. 22. **JUR.**

— ? *Hudlestoni*, Walker (see WALD. *Hudlestoni*). Ool. Sup., vol. iv, p. 133, pl. xvii, figs. 14—16. **JUR.**

— *hybrida*, Desl. Appendix to Sup., vol. v, p. 254, pl. xviii, fig. 12. **JUR.**

— *infra-oolitica*, E. Desl. Ool. Sup., vol. iv, p. 145, pl. xviii, figs. 8, 9. **JUR.**

— *insignis*, Schübler. Ool. Sup., vol. iv, p. 125, pl. xv, fig. 7. **JUR.**

— — var. *Maltonensis*, Oppel. (as T. *insignis*). Ool. Mon., vol. i, p. 47, pl. xiii, fig. 1; and Ool. Sup., vol. iv, p. 126, pl. xv, figs. 5, 6. **JUR.**

— *intermedia*, Sow. Ool. Mon., vol. i, p. 52, pl. xi, figs. 1—5; and Ool. Sup., vol. iv, p. 123, pl. xvii, fig. 12. **JUR.**

— — var. *Langtonensis*, Walker. Ool. Sup., vol. iv, p. 156, pl. xviii, fig. 14. **JUR.**

— *Jauberti*, E. Desl. Ool. Sup., vol. iv, p. 133, pl. xvii, fig. 13. **JUR.**

— *Joassi*, Dav. Ool. Sup., vol. iv, p. 124, pl. xv, fig. 4. **JUR.**

— *Kleinii*, Lamarck?; see TEREBRATULA *linguifera*.

— *Langtonensis*, Walker; see TEREBRATULA *intermedia*, var. *Langtonensis*.

— *Lankasteri*, Walk. Cret. Mon., vol. i, p. 38. **CRET.**

— *Leesii*, S. Buckman. Appendix to Sup., vol. v, p. 258, pl. xviii, fig. 16. **JUR.**

— *linguifera*, S. Buck. Appendix to Sup., vol. v, p. 260, pl. xix, fig. 1. **JUR.**

— *Maltonensis*, Oppel.; see TEREBRATULA *insignis*, var. *Maltonensis*.

maxillata, Sow. Ool Mon., vol. i, p. 50, pl. ix, figs. 1—9. Ool. Sup., vol. iv, p. 121; and Appendix to Sup., vol. v, p. 264, pl. xx, fig. 12. **JUR.**

— — var. *sub-maxillata*, Morris. Ool. Mon., vol. i, p. 51, pl. ix, figs. 10—12. Ool. Sup., vol. iv, p. 122. **JUR.**

— *Meyeri*, Walker. Cret. Sup., vol. iv, p. 44, pl. iii, figs. 6—8. **CRET.**

— *microtrema*, Walker. Cret. Sup., vol. iv, p. 37, pl. iii, figs. 18—21. **CRET.**

— ? *minuta*, Moore. Ool. Sup., vol. iv, p. 142, pl. xvii, fig. 11 (not 12). **JUR.**

— *Morierei*, E. Desl. Appendix to Sup., vol. v, p. 253, pl. xviii, fig. 11. **JUR.**

— *Moutoniana*, d'Arch. Cret. Sup., vol. iv, p. 42, pl. iv, figs. 11—13. App. to Sup., vol. v, p. 251. **CRET.**

— — var. *Brickhillensis*, W. Keeping. Appendix to Sup., vol. v, p. 251, pl. xviii, fig. 8. **CRET.**

— *Newtoniensis*, Dav.; see DIALASMA *Newtoniensis*.

— *obesa*, Sow. Cret. Mon., vol. i, p. 53, pl. v, figs. 13—16. Cret. Sup., vol. iv, p. 37. **CRET.**

— *ovata*, Sow. Cret. Mon., vol. i, p. 47, pl. iv, figs. 6—13, and Cret. Sup., vol. iv, p. 32, pl. ii, fig. 14. **CRET.**

TEREBRATULA *ovoides*, Sow. Ool. Mon., vol. i, p. 48, pl. viii, figs. 4, 5 (only). Drift Sup., vol. iv, p. 9, pl. i, figs. 12, 13 (14, 15, 16?). Appendix to Sup., vol. v, p. 243. It is a Cretaceous, not a Jurassic species. **CRET.**

— *Oxoniensis*, Walker. Ool. Sup., vol. iv, p. 126, pl. xv, figs. 8, 9. **JUR.**

— *perovalis*, Sow. Ool. Mon., vol. i, p. 51, pl. x, figs. 1—6. Ool. Sup., vol. iv, p. 122, pl. xvii, fig. 9. **JUR.**

— — var. *ampla*, Buckman. Ool. Sup., vol. iv, pl. xxv, fig. 2 (not 1). **JUR.**

— — var. *Kleinii* (not of Lamarck) is T. *linguifera*, Buckman. Appendix to Sup., vol. v, p. 260, pl. xix, fig. 1. **JUR.**

— ? *Perrieri*, E. Desl. Ool. Sup., vol. iv, p. 120, pl. xiv, figs. 1—3. **JUR.**

— *phaseolina*, Lamarck. Cret. Sup., vol. iv, p. 36, pl. v, fig. 17. **CRET.**

— *Phillipsiana*, Walker; see TEREBRATULA *Phillipsii*, var. *Phillipsiana*.

— *Phillipsii*, Morris. Ool. Mon., vol. i, p. 53, pl. xi, figs. 6—8, and vol. i, Appendix A, fig. 14. Ool. Sup., vol. iv, pl. xvii, figs. 10—17. **JUR.**

— — var. *Phillipsiana*, Walker. Ool. Sup., vol. iv, p. 156, pl. xvii, fig. 23. **JUR.**

— *plicata*, Buckman. Ool. Mon., vol. i, p. 60, pl. xii, figs. 1—5. **JUR.**

— *prælonga*, Sow. Cret. Mon., vol. i, p. 58, pl. vii, figs. 1, 2. Cret. Sup., vol. iv, p. 37, pl. iii, figs. 12, 13. **CRET.**

— *provincialis*, E. Desl. Appendix to Sup., vol. v, p. 260, pl. xix, fig. 5. **JUR.**

— *punctata*, Sow. Ool. Mon., vol. i, p. 45, pl. vi, figs. 1—10, 12, and 16. Ool. Sup., vol. iv, p. 130, pl. xvi, figs. 6—8, 11, 12, and var. 9, 10? **JUR.**

— — var. *Edwardsii*, Dav. Ool. Mon., vol. i, p. 30, pl. vi, figs. 11, 13, 14, 15. Ool. Sup., vol. iv, p. 131, pl. xvii, fig. 22. **JUR.**

— — var. *Haresfieldensis*, Dav. Ool. Sup., vol. iv, p. 132, pl. xvi, figs. 3—5. **JUR.**

— — var. *Radstockiensis*, Dav. Ool. Sup., vol. iv, p. 131, pl. xvi, figs. 14—18. **JUR.**

— *Radstockiensis*, Dav.; see TEREBRATULA *punctata*, var. *Radstockiensis*.

— *reticulata*, Sow.; see TEREBRATULA *coarctata*, var. *reticulata*.

— *Robertoni*, d'Arch.? Cret. Mon., vol. i, p. 72, pl. ix, fig. 25; and Cret. Sup., vol. iv, p. 42, pl. v, fig. 26. **CRET.**

— *sacculus*, Sow.; see DIELASMA *sacculus*.

— *Seeleyii*, Walker. Cret. Sup., vol. iv, p. 43, pl. vii, figs. 3, 4. **CRET.**

— *sella*, Sow. Cret. Mon., vol. i, p. 59, pl. vii, figs. 4—10. Cret. Sup., vol. iv, pp. 34, 35. **CRET.**

— — var. *Tornacensis*, d'Archiac, in part. Cret. Mon., vol. i, p. 61, pl. vii, figs. 11—16, and pl. ix, figs. 36, 37. **CRET.**

— — var. *Upwarensis*, Walker. Cret. Sup., vol. iv, p. 35, pl. v, figs. 3—10. **CRET.**

— *semiglobosa*, Sow. Cret. Sup., vol. iv, p. 45, pl. viii, figs. 6—18. **CRET.**

— — var. *Hibernica*, Tate. Cret. Sup., vol. iv, p. 45, pl. ii, figs. 18—20. **CRET.**

— *Sherbornensis*, S. Buck. Appendix to Sup., vol. v, p. 261, pl. xix, fig. 5. **JUR.**

— *simplex*, Buckman. Ool. Mon. vol. i, p. 48, pl. viii, figs. 1—3. Appendix to Sup., vol. i, p. 18. **JUR.**

— *sphæroidalis*, Sow. Ool. Mon., vol. i, p. 56, pl. ix, figs. 9—15 and 18 (not 16, 17, 19); and Appendix to vol. i, pl. A, fig. 16? Ool. Sup., vol. iv, p. 134, pl. xviii, fig. 15. **JUR.**

— *squamosa*, Mantell. Cret. Mon., vol. i, p. 50, pl. v, figs. 5—11. Cret. Sup., vol. v, p. 33, pl. ii, fig. 15. **CRET.**

— *Stephani*, Dav. Ool. Sup., vol. iv, p. 147, pl. xviii, figs. 1—7. **JUR.**

— *sub-maxillata*, Morris; see TEREBRATULA *maxillata*, var. *sub-maxillata*.

TEREBRATULA *subsella*, Leymerie. Ool. Sup., vol. iv, p. 148, pl. xix, figs. 10—12. **JUR.**
— ? *Suessi*, E. Desl. Ool. Sup., vol. iv, p. 119, pl. xiv, figs. 4—6. **JUR.**
— *sufflata*, Sch.; see DIELASMA *elongata*, var. *sufflata*.
— *sulcifera*, Morris. Cret. Mon., vol. i, p. 64, pl. vii, figs. 17—20. Cret. Sup., vol. iv, p. 37. **CRET.**
— *Tawneyi*, Whidborne. Appendix to Sup., vol. v, p. 255, pl. xviii, fig. 14. **JUR.**
— *Tornacensis*, d'Archiac; see TEREBRATULA *sella*, var. *Tornacensis*.
— *trilineata*, Young and Bird. Ool. Mon., vol. i, p. 48, pl. viii, figs. 6, 7. Ool. Sup., vol. iv, p. 128, pl. xvi, figs. 1, 2 (not T. *ovoides*, Sow.). **JUR.**
— *uniplicata*, Walker; see TEREBRATULA *depressa*, var. *uniplicata*.
— *Upwarensis*, Walker; see TEREBRATULA *sella*, var. *Upwarensis*.
— *ventricosa*, Hartmann (?). Ool. Sup., vol. iv, p. 127, pl. xv, figs. 10, 11. **JUR.**
— *vesicularis*, De Kon.; see DIELASMA *vesicularis*.
— *Walfordi*, Dav. Ool. Sup., vol. iv, p. 156, pl. xix, figs. 18, 19. **JUR.**
— *Whitakeri*, Walker. Ool. Sup., vol. iv, p. 152, pl. xix, figs. 6—9. **JUR.**
— *Wrightii*, Dav. Appendix to vol. i, p. 21, pl. A, fig. 17. Ool. Sup., vol. iv, p. 140. **JUR.**
TEREBRATULINA *caput-serpentis*, Linné. Sup., Recent and Ter. Brach., vol. iv, p. 3. Tert. Sup., vol. iv, pp. 9—14, and Tert. Mon., vol. i, p. 12, pl. i, figs. 3—6. **REC.—TERT.**
— *Defrancii*, Dav.; see TEREBRATULINA *striata*, var. *Defrancei*.
— ? *Deslongchampsii*, Dav. Ool. Sup., vol. iv, p. 117. **JUR.**
— *Dundriensis*, Dav.; see TEREBRATULINA *radiata*, var. *Dundriensis*.
— *elongata*, Dav.; see TEREBRATULINA *striata*, var. *elongata*.
— *gracilis*, Schl. Cret. Mon., vol. i, p. 38, pl. ii, figs. 13—15 (not 16, 17). Cret. Sup., vol. iv, p. 31. Appendix to Sup., vol. v, p. 244. **CRET.**
— ? *granulosa*, Dav. Ool. Mon., vol. i, p. 18, pl. i, fig. 20. Ool. Sup., vol. iv, p. 118, pl. xiv, figs. 11, 12. **JUR.**
— *Martiniana*, d'Orb. Cret. Mon., vol. i, pl. ii, fig. 26. Cret. Sup., vol. iv, p. 31. **CRET.**
— *radiata*, Moore. Ool. Sup., vol. iv, p. 116, pl. xiv, figs. 7—9. **JUR.**
— — var. *Dundriensis*, Dav. Ool. Sup., vol. iv, p. 117, pl. xiv, fig. 10. **JUR.**
— *rigida*, Sow. Cret. Mon., vol. i, pl. ii, figs. 16, 17 (not T. *rigida*, Sow.; see T. *triangularis*, Etheridge). Cret. Sup., vol. iv, p. 32. **CRET.**
— *striata*, Sow. Cret. Mon., vol. i, p. 35, pl. ii, figs. 18—23 (not 26—28?). Cret. Sup., vol. iv, p. 29. **CRET.**
— — var. *Defrancei*, Dav. Cret. Sup., vol. iv, p. 30, pl. ii, fig. 13. **CRET.**
— — var. *elongata*, Dav. Cret. Sup., vol. iv, p. 30. **CRET.**
— *striatula*, Sow. Tert. Mon., vol. i, p. 14, pl. i, fig. 16. Tert. Sup., vol. iv, p. 14. **TERT.**
— *triangularis*, Etheridge. Appendix to Sup., vol. v, p. 245, pl. xviii, fig. 3. **CRET.**
TEREBIROSTRA *lyra*, Sow. sp. Cret. Mon., vol. i, p. 32, pl. iii, figs. 17—28. Cret. Sup., vol. iv, p. 28. Appendix to Sup., vol. v, p. 243, pl. xviii, figs. 1, 2. **CRET.**
THECIDIUM *Bouchardii*, Dav. Ool. Mon., vol. i, p. 14, pl. i, figs. 15, 16. Ool. Sup., vol. iv, p. 106, pl. xiii, figs. 1—3. **JUR.**
— *Deslongchampsii*, Dav. Appendix to vol. i, p. 14, pl. A, fig. 6. **JUR.**
— *Dickinsoni*, Moore. Ool. Mon., vol. i, p. 14, pl. xiii, fig. 19. Ool. Sup., vol. iv, p. 106. **JUR.**
— *duplicatum*, Moore. Appendix to vol. i, p. 30. Ool. Sup., p. 108, pl. xii, figs. 15—20. **JUR.**
— *Faringdonense*, Meyer. Cret. Sup., vol. iv, p. 23, pl. ii, figs. 11, 12. **CRET.**
— *Forbesi*, Moore. Ool. Sup., vol. iv, p. 109, pl. xii, figs. 6—9. **JUR.**

THECIDIUM ? *granulosum*, Moore. Ool. Sup., vol. iv, p. 110, pl. xii, figs. 1—5. **JUR.**

— *Moorei*, Dav. Ool. Mon., vol. i, p. 13, pl. i, fig. 10; and Ool. Sup., vol. iv, p. 105. **JUR.**

— *ornatum*, Moore. Ool. Sup., vol. iv, p. 104, pl. xiii, figs. 5—9. **JUR.**

— ? *pygmæum*, Moore. Ool. Sup., vol. iv, p. 105, pl. xiii, fig. 16. **JUR.**

— *rusticum*, Moore. Ool. Mon., vol. i, p. 15, pl. i, fig. 14; and Ool. Sup., vol. iv, p. 107, pl. xiii, fig. 10. **JUR.**

— *septatum*, Moore. Appendix to vol. i, p. 30; and Ool. Sup., vol. iv, p. 109, pl. xii, figs. 22—24. **JUR.**

— *serratum*, Moore. Appendix to vol. i, p. 30; and Ool. Sup., vol. iv, p. 108, pl. xii, figs. 10—14. **JUR.**

— *sub-serratum*, Tate. Ool. Sup., vol. iv, p. 107, pl. xiii, figs. 11—13. **JUR.**

— *triangulare*, d'Orb. Ool. Mon., vol. i, p. 14, pl. i, figs. 11, 12, and Ool. Sup., vol. iv, p. 106, pl. xii, figs. 25, 26. **JUR.**

— *Wetherelli*, Morris. Cret. Mon. vol. i, p. 14, pl. i, figs. 15—26, not xii, fig. 39. Cret. Sup., vol. iv, p. 22. **CRET.**

TREMATIS (DISCINA) *corona*, Salter. Sil. Mon., vol. iii, p. 344, pl. xlix, figs. 43, 44. **SIL.**

— *punctata*, Sow. Sil. Mon., vol. iii, p. 69, pl. vi, fig. 9. **SIL.**

— *Siluriana*, Dav. Sil. Mon., vol. iii, p. 71, pl. vi, fig. 8. **SIL.**

TRIGONOSEMUS *elegans*, Kœnig. Cret. Mon., vol. i, p. 29, pl. iv, figs. 1—4. Cret. Sup., vol. iv, p. 28. **CRET.**

— *incertus*, Dav. Cret. Mon., vol. i, p. 31, pl. iv, fig. 5. Cret. Sup., vol. iv, p. 28. **CRET.**

TRIPLESIA ? *apiculata*, Salter (as ATRYPA). Sil. Mon., vol. iii, p. 202, pl. xxv, fig. 6. Sil. Sup., p. 145. **SIL.**

— ? *Grayiæ*, Dav. Sil. Mon., vol. iii, p. 198, pl. xxiv, figs. 31, 32; pl. xxv, figs. 9—11. Sil. Sup., vol. v, p. 144, pl. viii, fig. 32. **SIL.**

— ? *incerta* (as ATRYPA ?), Dav. Sil. Mon., vol. iii, p. 203, pl. xxiv, fig. 30; pl. xxv, figs. 7, 8. Sil. Sup., vol. v, p. 145, pl. viii, figs. 24—29. **SIL.**

— *insularis*, Eichw. (ORTHIS). Sil. Mon., vol. iii, p. 373, pl. xxxvii, figs. 8—15. Sil. Sup., vol. v, p. 143, pl. viii, figs. 17—22. **SIL.**

— ? *Maccoyana*, Dav. Sil. Sup., vol. iii, p. 199, pl. xxiv, fig. 20. **SIL.**

— ? *monilifera*, M'Coy. Sil. Mon., vol. iii, p. 200, pl. xxv, figs. 3, 5. Sil. Sup., vol. v, p. 147, pl. viii, fig. 31. **SIL.**

— ? *spiriferoides*, M'Coy (as ORTHIS). Sil. Mon., vol. iii, p. 275, pl. xxxvii, figs. 3—7. Sil. Sup., vol. v, p. 146, pl. viii, fig. 30. **SIL.**

— *Wenlockiensis*, Dav. Sil. Mon., vol. iii, p. 144, pl. viii, fig. 23. **SIL.**

UNCITES *gryphus*, Schlot. Dev. Mon., vol. iii, p. 22, pl. iv, figs. 11, 12. Dev. Sup., vol. v, p. 30, pl. iii, figs. 4—10. **DEV.**

WALDHEIMIA *Anglica* (TEREB.?), Oppel. Ool. Sup., vol. iv, pp. 135, 186, pl. xxiii, figs. 23—26; and Appendix to Sup., vol. v, p. 270, pl. xx, fig. 15. **JUR.**

— *Bakeriæ*, Dav. Ool. Mon., vol. i, p. 38, pl. v, fig. 11. Ool. Sup., vol. iv, p. 179. **JUR.**

— *bicarinata*, Angelin = WALDHEIMIA. *Mawei*, Sil. Sup., vol. v, p. 76, pl. iv, figs. 1—3. **SIL.**

— *bisulcata*, S. Buck. App. to Sup., vol. v, p. 268, pl. xix, figs. 9, 10. **JUR.**

— *Bonneyi*, W. Keeping. Appendix to Sup., vol. v, p. 247, pl. xviii, fig. 9. **CRET.**

— *Blakei*, Walker; see WALDHEIMIA *carinata*, var. *Blakei*.

— *Brodiei*, S. Buck. Appendix to Sup., vol. v, p. 266, pl. xix, figs. 14, 15. **JUR.**

WALDHEMIA *bucculenta*, Dav. Ool. Mon., vol. i, p. 55, pl. xiii, fig. 8, and Ool. Sup., p. 173, pl. xxii, fig. 23, and pl. xxiv, figs. 23—26. **JUR.**
— *bullata*, Sow. Ool. Sup., vol. iv, p. 187, pl. xxi, figs. 21, 22. **JUR.**
— *Cadomensis*, E. Desl. Ool. Mon., vol. i, pl. vii, fig. 9 (as C. *ornithocephalus*). Ool. Sup., vol. iv, p. 170, pl. xxii, fig. 9; and pl. xxiv, figs. 14, 15. **JUR.**
— *cardium*, Lam. Ool. Mon., vol. i, p. 43, pl. xii, figs. 13—18. Ool. Sup., vol. iv, p. 185, pl. xxiv, figs. 21, 22. **JUR.**
— *carinata*, Lam. Ool. Mon., vol. i, p. 35, pl. iv, figs. 11—14 (not 15—17). Ool. Sup., vol. iv, p. 179, pl. xxiii, figs. 14, 15. **JUR.**
— — var. *Blakei*, Walker. Ool. Sup., vol. iv, p. 181, pl. xxiii, figs. 19, 20. **JUR.**
— — var. *Crewkerniensis*, S. Buckman. Appendix to Sup., vol. v, p. 268, pl. xix, fig. 8. **JUR.**
— — var. *Mandelslohi*, Oppel. Ool. Sup., vol. iv, p. 180, pl. xxiii, figs. 16—18. **JUR.**
— *Celtica*, Morris. Cret. Mon., vol. i, p. 73, pl. ix, figs. 32—35; and Cret. Sup., vol. iv, p. 47, pl. vi, fig. 15. **CRET.**
— *cor*, Lamarck? App. to Sup., vol. v, p. 269, pl. xix, fig. 16. **JUR.**
— *cornuta*, Sow.; see WALDHEIMIA *quadrifida*, var. *cornuta*.
— *Crewkerniensis*, Buckman; see WALDHEIMIA *carinata*, var. *Crewkerniensis*.
— *Darwini*, E. Desl. Ool. Sup., vol. iv, p. 163, pl. xxiv, figs. 9—11. **JUR.**
— *digona*, Sow. Ool. Mon., vol. i, p. 38, pl. v, figs. 18—24, and Ool. Sup., vol. iv, p. 173, pl. xxii, figs. 21, 22. **JUR.**
— *disculus*, Waagen. Appendix to Sup., vol. v, p. 266, pl. xix, fig. 17. **JUR.**
— *Dorsetensis*, Walker. Ool. Sup., vol. iv, p. 176, pl. xxiv, figs. 6—8. **JUR.**
— *emarginata*, Sow. Ool. Mon., vol. i, p. 35, pl. iv, figs. 18—21; and Ool. Sup., vol. iv, p. 161, pl. xxiii, figs. 5—7. **JUR.**
— *faba*, d'Orb. (not of Sow.). Cret. Sup., vol. iv, p. 55, pl. vi, figs. 12—14. **CRET.**
— *florella*, d'Orb. Ool. Sup., vol. iv, p. 178, pl. xxiii, figs. 11—13. **JUR.**
— ? *Glassii*, Dav. Sil. Sup., vol. v, p. 77, pl. iv, fig. 4. **SIL.**
— *Haasi*, S. Buck. Appendix to Sup., vol. v, p. 265, pl. xix, figs. 11, 12. **JUR.**
— ? *Hibernica*, Tate. Cret. Sup., vol. iv, p. 50, pl. vii, fig. 21. **CRET.**
— *hippopus*, Roemer; var. *Tilbyensis*, Dav. Cret. Sup., vol. iv, p. 53, pl. vi, figs. 10, 11. **CRET.**
— *Huddlestoni*, Walker. Ool. Sup., vol. iv, pp. 135, 186, pl. xvii, figs. 14—16. **JUR.**
— *Hughesi*, Walker. Ool. Sup., vol. iv, p. 174. Appendix to Sup., vol. v, p. 267, pl. xviii, figs. 23, 24. **JUR.**
— ? *humeralis*, Roemer. Ool. Sup., vol. iv, p. 183, pl. xxiv, figs. 18, 19. **JUR.**
— *impressa*, von Buch. Ool. Mon., vol. i, p. 33, pl. iv, fig. 9, 10 (not 8). Ool. Sup., vol. iv, p. 182, pl. xxiv, fig. 32. **JUR.**
— *indentata*, Sow. Ool. Mon., vol. i, p. 46, pl. v, figs. 25, 26. Ool. Sup., vol. iv, p. 159, pl. xxi, figs. 10—15. **JUR.**
— *Juddii*, Walker. Cret. Sup., vol. iv, p. 50, pl. vii, figs. 15—18. **CRET.**
— *juvenis*, Sow. (as TEREBRATULA). Dev. Mon., vol. iii, p. 8, pl. i, figs. 10—15, and Dev. Sup., vol. v, p. 13, pl. i, figs. 1, 2. **DEV.**
— *lagenalis*, Schl. Ool. Mon., vol. i, p. 42, pl. vii, figs. 1—4 and 14. Ool. Sup., vol. iv, p. 168. **JUR.**
— *lampas*, Sow. Ool. Sup., vol. iv, p. 169, pl. xxii, figs. 3—6. **JUR.**
— *Leckenbyi*, Walker. Ool. Mon. Appendix to vol. i, pl. A, fig. 19 (as W. *submaxillata*). Ool. Sup., vol. iv, p. 183, pl. xxiii, figs. 1—4. **JUR.**

WALDHEIMIA *Lycetti*, Dav. Ool. Mon., vol. i, p. 44, pl. vii, figs. 17—22, and Ool. Sup., vol. iv, 175, pl. xxiv, figs. 30, 31. **JUR.**

— *magna*, Walker; see WALDHEIMIA *tamarindus*, var. *magna*.

— *Mandelslohi*, Oppel.; see WALDHEIMIA *carinata*, var. *Mandelslohi*.

— *margarita*, Oppel. Ool. Sup., vol. iv, p. 176, pl. xxiv, figs. 12, 13. **JUR.**

— *Mariæ*, d'Orb. Ool. Sup., vol. iv, p. 158, pl. xxi, figs. 16—18. **JUR.**

— *Meriani*, Op. (as T. *impressa*, pars.). Ool. Mon., vol. i, p. 33, pl. iv, fig. 8, pl. x, fig. 7; vol. iv, p. 181. **JUR.**

— *Moorei*, Dav. Ool. Mon., vol. i, p. 33, pl. iv, figs. 6, 7. Ool. Sup. vol. iv, p. 179. **JUR.**

— *Morrisii*, Meyer. Cret. Sup., vol. iv, p. 47, pl. vii, figs. 10—14. **CRET.**

— *numismalis*, Lamarck. Ool. Mon., vol. i, p. 36, pl. v, figs. 4—9. Ool. Sup., vol. iv, p. 162, pl. xxi, figs. 8, 9. **JUR.**

— *obovata*, Sow. Ool. Mon., vol. i, p. 39, pl. v, figs. 14—17, and pl. vii, fig. 5. Ool. Sup., vol. iv, p. 171, pl. xxii, figs. 10, 11. **JUR.**

— — var. *Siddingtonensis*, Walker. Ool. Sup., vol. iv, p. 172, pl. xxii, figs. 12—14. **JUR.**

— — var. *Stiltonensis*, Walker. Ool. Sup., vol. iv, p. 172, pl. xxii, figs. 17—20. **JUR.**

— — var. *sub-ovata*, Walker. Ool. Sup., vol. iv, p. 172, pl. xxii, figs. 15, 16. **JUR.**

— *ornithocephala*, Sow. Ool. Mon., vol. i, p. 40, pl. vii, figs. 6—8, 10—13. Ool. Sup., vol. iv, pp. 165 and 167, pl. xxii, figs. 1, 2, pl. xxiv, fig. 27. **JUR.**

— *perforata*, Piette. Ool. Sup., vol. iv, p. 164, pl. xxiv, figs. 1—3 and 5? **JUR.**

— *pseudo-jurensis*, Leymerie. Cret. Sup., vol. iv, p. 48, pl. vii, figs. 10—14. **CRET.**

— *quadrifida*, Lam. Ool. Mon., vol. i, p. 28, pl. iii, figs. 8—10. Ool. Sup., vol. iv, p. 157, pl. xxi, fig. 20. **JUR.**

— — var. *cornuta*, Sow. Ool. Mon., vol. i, p. 29, pl. iii, figs. 11—18. Ool. Sup., vol. iv, p. 158, pl. xxi, fig. 19. **JUR.**

— *resupinata*, Sow. Ool. Mon., vol. i, p. 31, pl. iv, figs. 1—5. Ool. Sup., vol. iv, p. 177. **JUR.**

— *reversa*, S. Buckman. App. to Sup., vol. v, p. 267, pl. xix, fig. 13, and pl. xx, fig. 13. **JUR.**

— *Siddingtonensis*, Walker; see WALDHEIMIA *obovata*, var. *Siddingtonensis*.

— *Stiltonensis*, Walker; see WALDHEIMIA *obovata*, var. *Stiltonensis*.

— *sub-numismalis*, Dav. Ool. Mon., vol. i, p. 38, pl. v, fig. 10. Ool. Sup., vol. iv, p. 162, pl. xxi, figs. 1—7; and Appendix to Sup., vol. v, pl. xx, fig. 14. **JUR.**

— *subovata*, Walker; see WALDHEIMIA *obovata*, var. *subovata*.

— *tamarindus*, Sow. Cret. Mon., vol. i, p. 74, pl. ix, figs. 26—31. Cret. Sup., vol. iv, p. 49. **CRET.**

— — var. *magna*, Walker. Cret. Sup., vol. iv, p. 49, pl. vi, figs. 16—19; and pl. vii, figs. 5, 9. **CRET.**

— *umbonella*, Lam. Ool. Sup., vol. iv, p. 168, pl. xxii, figs. 7, 8. **JUR.**

— *Walkeri*, Dav. Cret. Sup., vol. iv, p. 54, pl. vi, figs. 6—9. **CRET.**

— *Waltoni*, Dav. Ool. Mon., vol. i, p. 36, pl. v, figs. 1—3, and Ool. Sup., vol. iv, p. 161, pl. xxiii, figs. 8—10. **JUR.**

— *Wanklyni*, Walker. Cret. Sup., vol. iv, p. 51, pl. vii, figs. 22—28. **CRET.**

Waterhousii, Dav. Ool. Mon., vol. i, p. 31, pl. v, figs. 12, 13. Ool. Sup., vol. iv, p. 174. **JUR.**

— ? *Whidbornei*, Dav. (TER. *sacculus*, Dav., not of Martin). Dev. Mon., vol. iii, p. 6, pl. i, figs. 1—8. Dev. Sup., vol. v, p. 12, pl. i, figs. 3, 4. **DEV.**

Waldheimia *Woodwardi*, Walker. Cret. Sup., vol. iv, p. 52, pl. vi, figs. 1—5. **CRET.**
Whitfieldia *tumida*, Dalman (as Meristella *tumida*, Dav.). Sil. Mon., vol. iii, p. 109, pl. xi, figs. 1—13. Sil. Sup., vol. v, p. 107, pl. v, figs. 5, 6; and pl. vi, figs. 1—9. **SIL.**

Zellania *Davidsoni*, Moore. Ool. Sup., vol. iv, p. 112, pl. xi, figs. 18, 19. **JUR.**
— *globata*, Moore. Ool. Sup., vol. iv, p. 113, pl. xi, figs. 25—27. **JUR.**
— *Laboucherei*, Moore. Ool. Sup., vol. iv, p. 112, pl. xi, figs. 20, 21. **JUR.**
— *liasiana*, Moore. Ool. Sup., vol. iv, p. 112, pl. xi, figs. 23, 24. **JUR.**
— *obesa*, Moore. Ool. Sup., vol. iv, p. 114, pl. xi, fig. 22. **JUR.**
— *oolitica*, Moore. Ool. Sup., vol. iv, p. 113, pl. xi, fig. 28. **JUR.**
Zigospira *Anticostiensis*, Billings. Sil. Mon., vol. iii, pl. xxii, figs. 1—8 (figured on the plates but not described in vol. iii as Atrypa *Headii*, var. *Anglica*); and Sil. Sup., vol. v, pp. 127, 423. **SIL.**

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APPENDIX TO SUPPLEMENTS, PLATE XVIII.

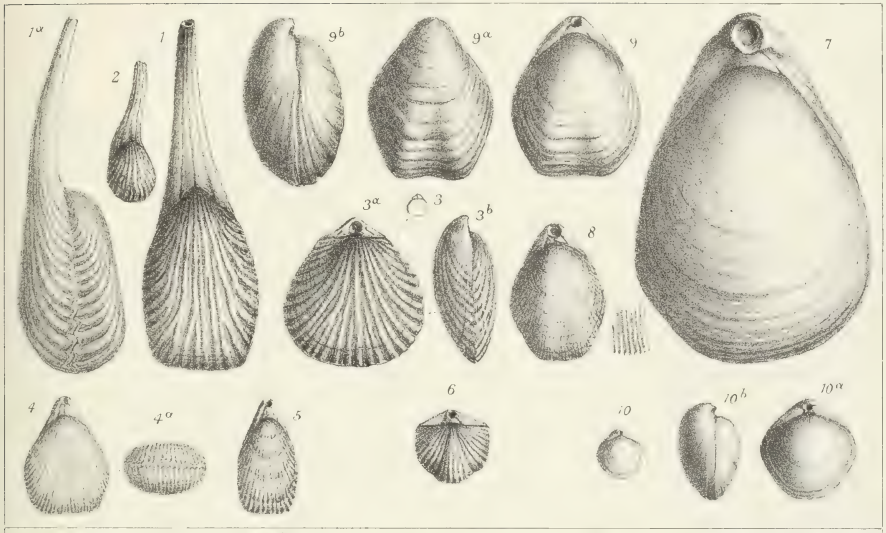
CRETACEOUS.

Fig.		
1, 1 *a*, 2.	*Terebrirostra lyra*, Sow., sp.	Upper Greensand, Horningsham. 1. A very large example. 2. A smaller specimen, showing a twisted beak. British Museum. (P. 243.)
3, 3 *a*, *b*.	*Terebratulina triangularis*, Etheridge, sp.	3 *a*, *b*. Enlarged. Upper Greensand, Cambridge. Museum of School of Mines. Mr. Etheridge's type. (P. 245.)
4, 4 *a*, 5.	*Terebratella Keepingii*, Walker, MS.	Middle Neocomian, Brickhill, Bedfordshire. 5. Woodwardian Museum, Cambridge. (P. 245.)
6.	,, *Menardi*, Lam.	Middle Neocomian, Upware, Cambridgeshire. Woodwardian Museum, Cambridge. (P. 247.)
7.	*Terebratula depressa*, Lam.	Middle Neocomian, Brickhill. Woodwardian Museum, Cambridge. (P. 251.)
8.	,, *Moutoniana*, d'Orb., var. *Brickhilliensis*.	W. Keeping, Brickhill. Woodwardian Museum. (P. 251.)
9, 9 *a*, *b*.	,, *Bonneyi*, W. Keeping.	Middle Neocomian, Brickhill. Keeping's type. Woodwardian Museum. (P. 247.)
10, 10 *a*, *b*.	*Kingena? rhomboidalis*, W. Keeping.	Middle Neocomian, Brickhill type. Woodwardian Museum. 10 *a*, *b*. Enlarged. (P. 246.)

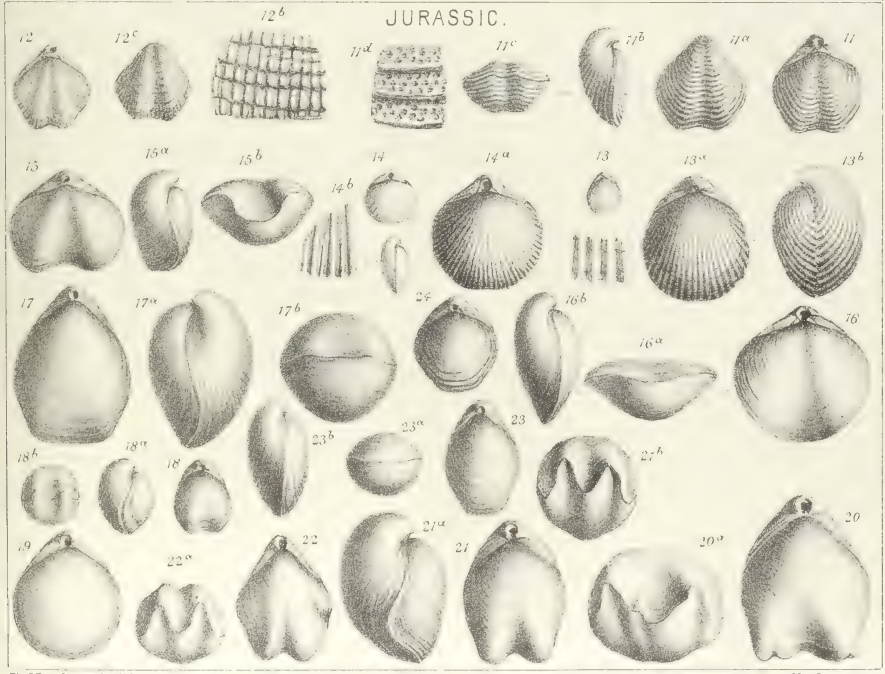
JURASSIC SPECIES.

11, 11 *a—d*.	*Terebratula Morierei*, E. Desl.	A large example. Inf. Oolite, *Am. Parkinsoni* zone, Bradford Abbas, Dorsetshire. Coll. of Mr. S. S. Buckman. 11 *d*. A portion of the shell, magnified to show the large punctures. (P. 253.)
12 *a*, *b*, *c*.	,, *hybrida*, E. Desl.	Inf. Oolite. Top bed with *Am. zigzag*. Zone of *Am. Parkinsoni*. Broadwindsor, Dorset. Coll. of Mr. D. Stephens. 12 *b*. Portion of shell magnified. (P. 254.)
13, 13 *a*, *b*.	?	Middle Lias, Munger Quarry, Radstock. Coll. of Mr. E. Purvis. This specimen is probably not a brachiopod, although it closely resembles one. Mr. Purvis thinks it may be a specimen of *Cardita multicostata*. (P. 264.)
14, 14 *a*, *b*.	,, *Tawnei*, Whidborne.	Inf. Oolite, Dundry. Coll. of Rev. G. F. Whidborne. (P. 255.)
15, 15 *a*, *b*.	,, *curviconcha*, Oppel.	Inf. Oolite, zone of *Am. Humphriesiana*, Half-Way House, Sherborne, Dorset. Coll. of Mr. S. S. Buckman. (P. 256.)
16, 16 *a*, *b*.	,, *Leesii*, S. S. Buckman.	Inf. Oolite. Zone of *Am. Murchisoniæ*. Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 258.)
17, 17 *a*, *b*.	,, *gravida*, Szajnocha.	Inf. Oolite. Zone of *Am. Humphriesiana*. Half-Way House, Sherborne. Coll. of Mr. S. S. Buckman. (P. 261.)
18, 18 *a*, *b*.	,, *Eudesiana*, S. S. Buckmann.	Inf. Oolite. Zone of *Am. Sowerbyi*. Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 255.)
19.	,, *Boloniensis*, Rigaux.	Portland Stone, St. Alban's Head, Portland. Coll. of Rev. Prof. J. F. Blake. (P. 256.)
20, 20 *a*, 21, 21 *a*, *b*.	,, *Ferryi*, E. Desl.	20. Inf. Oolite. *Am. Parkinzoni* zone, near Orborne, Dorset. 21. From the same zone near Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 257.)
22.	,, *Hollandæ*, S. S. Buckman.	Inf. Oolite. *Am. Parkinsoni* zone. Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 258.)
23, 23 *a*, *b*, 24.	*Waldheimia Hughesi*, Walker, MS.	Inf. Oolite. Lower Trigonia Grit, Leckhampton Hill, Cheltenham. Coll. of Mr. Walker. (P. 267.)

CRETACEOUS.



JURASSIC.



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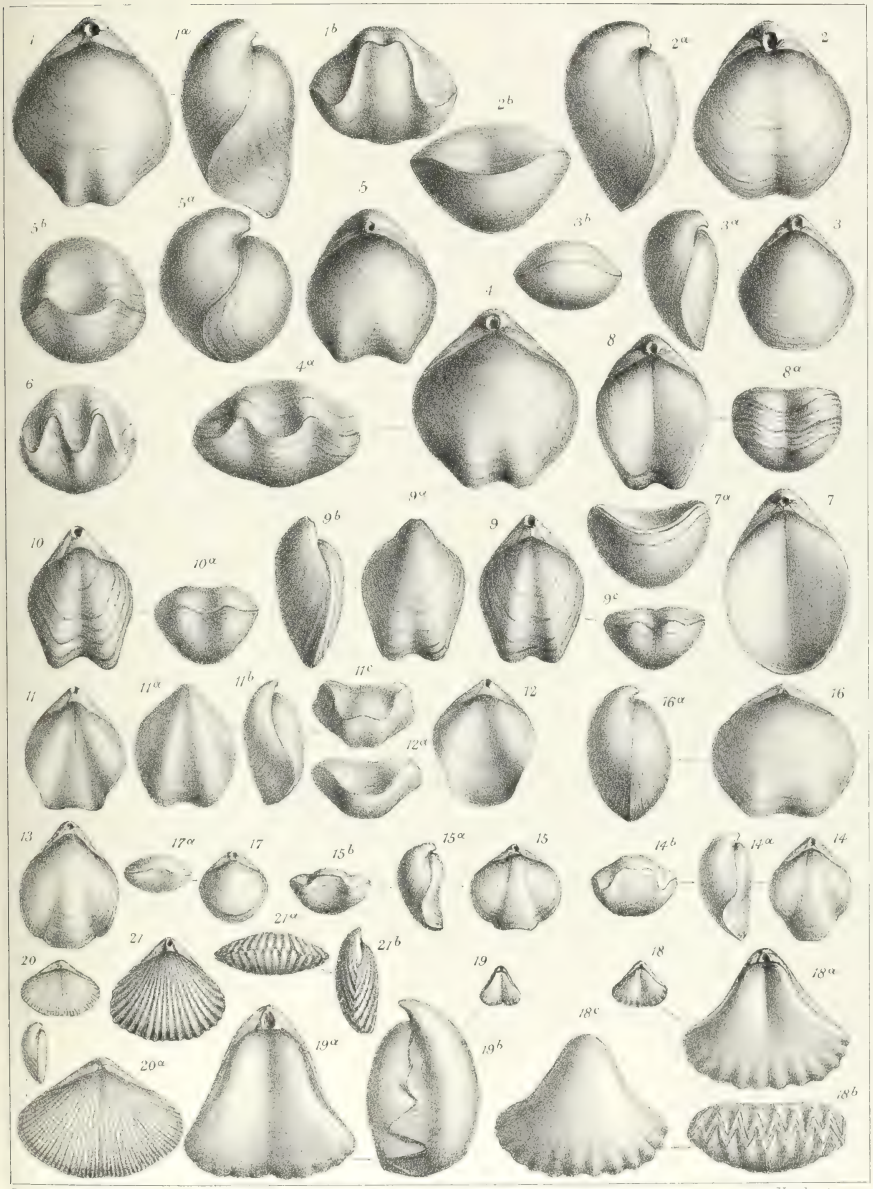
APPENDIX TO SUPPLEMENTS, PLATE XIX.

JURASSIC.

Fig.		
1, 1 *a*, *b*.	*Terebratula linguifera*, S. S. Buckman.	Fuller's earth rock, Haydon, Dorset. Coll. of Mr. S. S. Buckman. (P. 260.)
2, 2 *a*, *b*.	„ *provincialis*, Desl. ?	Inf. Oolite, Hawthorn Down, near Corton Denham, Somerset. Coll. of Mr. S. S. Buckman. (P. 260.)
3 3 *a*, *b*.	„ *Cortonensis*, S. S. Buckman's type.	Inf. Oolite, zone of *Am. Sowerbyi*, Corton Denham, Somerset. Coll. of Mr. S. S. Buckman. (P. 259.)
4, 4 *a*.	„ *Fleischeri* ? Oppel.	Inf. Oolite, near Sherborne, Dorset. Coll. of Mr. S. S. Buckman. (P. 262.)
5, 5 *a*, *b*.	„ *Sherbornensis*, S. S. Buckman.	Inf. Oolite, zone of *Am. Murchisoniæ*, near Sherborne, Dorset. Coll. of Mr. S. S. Buckman. (P. 261.)
6.	„ *Eudesi*, Oppel.	Front view of a typical specimen. Inf. Oolite, Dundry. So identified by Dr. Oppel himself. (P. 262.)
7, 7 *a*.	*Waldheimia carinata*, Lam.	A fine large example. Inf. Oolite, Bradford Abbas, Dorset. Coll. of Mr. S. S. Buckman. (P. 268.)
8, 8 *a*.	„ „ var. *Crewkerniensis*, S. S. Buckman.	Inf. Oolite, zone of *Am. Parkinsoni*, Haselbury, near Crewkerne. Coll. of Mr. S. S. Buckman. (P. 268.)
9, 9 *a*, *b*, 10, 10 *a*.	„ *bisulcata*, S. S. Buckman.	Inf. Oolite, *Parkinsoni* zone. 9. Bradford Abbas. Coll. of Mr. S. S. Buckman. 10. Same locality. Coll. of Rev. G. F. Whidborne. (P. 268.)
11, 11 *a*, *b*, *c*, 12, 12 *a*.	„ *Haasi*, S. S. Buckman.	Inf. Oolite, *Am. Humphriesianus* zone, Halfway House, Sherborne, Dorset. Coll. of Mr. S. S. Buckman. 12. A typical specimen. 11. A somewhat scarce variation in form. (P. 265.)
13.	„ *reversa*, S. S. Buckman.	Inf. Oolite, zone of *Am. Humphriesianus*. Orborne, Dorset. Coll. of Mr. S. S. Buckman. (P. 267.)
14, 14 *a*, *b*, 15, 15 *a*, *b*.	„ *Brodiei*, S. S. Buckman.	Inf. Oolite, zone of *Am. Humphriesianus*, Louse Hill, near Sherborne, Dorset. Coll. of Mr. S. S. Buckman. (P. 266.)
16, 16 *a*.	„ *Cor*, Lamarck ?.	Middle Lias, West Tyning, near Radstock. Coll. of Rev. G. F. Whidborne. (P. 269.)
17, 17 *a*.	„ *disculus*, Waagen.	Inf. Oolite, *Am. Sowerbyi* zone, near Corton, Denham, Somerset. Coll. of Mr. S. S. Buckman. (P. 266.)
18, 18 *a*, *b*, *c*, 19, 19 *a*, *b*.	*Rhynchonella bilobata*, S. S. Buckman.	Inf. Oolite, *Am. Sowerbyi* zone, Bradford Abbas, Dorset, and Corton Denham, Somerset. 18, 19. Nat. size. Others enlarged. 19. Coll. of Mr. S. S. Buckman. (P. 272.)
20, 20 *a*.	„ *Dundriensis*, S. S. Buckman.	Inf. Oolite, Bradford Abbas, Dorset. Coll. of Mr. S. S. Buckman. (P. 272.)
21, 21 *a*, *b*.	„ *palma*, Szajnocha.	Inf. Oolite, Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 271.)



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APPENDIX TO SUPPLEMENTS, PLATE XX.

JURASSIC.

FIG.

1, 1 *a*. *Rhynchonella Gingensis*, Waagen. Inf. Oolite, Bradford Abbas, Dorsetshire. Coll. of Mr. S. S. Buckman. (P. 275.)

2, 2 *a*, *b*, *c*. „ *Dorsetiensis*, S. S. Buckman. Inf. Oolite, zone of *Am. Humphriesiana*, Half-Way House, Sherborne, Dorset. Coll. of Mr. S. S. Buckman. 2. Nat. size. 2 *c*. Enlarged. (P. 277.)

3. „ *Balinensis*, Szajnocha (according to Mr. S. S. Buckman). Inf. Oolite, zone of *Am. Sowerbyi*, Bradford Abbas, Somersetshire. Coll. of Mr. S. S. Buckman. (P. 277.)

4 *a*, *b*, 5. „ *fallax*, E. Desl. Middle Lias, Huish Quarry, Radstock. 5. Coll. of Rev. G. F. Whidborne. (P. 275.)

6, 6 *a*, *b*, *c*. „ *Portlandica*, Blake. Portland sand, Blackven, Portland. 6. A specimen with one rib on mesial fold, nat. size, after Blake. 6 *a*, *b*, *c*. A biplicated example enlarged, also from the coll. of Rev. J. F. Blake. (P. 273.)

7, 7 *a*, *b*. „ *Buteo*, Szajnocha (according to Mr. S. S. Buckman). Inf. Oolite, zone of *Am. Sowerbyi*, Bradford Abbas, Dorset. Coll. of Mr. S. S. Buckman. (P. 276.)

8, 9, 9 *a*, 10, 10 *a*. „ *Beneckei*, Haas (according to Buckman). Inf. Oolite, zone of *Am. Jurensis*, Bradford Abbas. Coll. of Mr. S. S. Buckman. (P. 274.)

11, 11 *a*. „ sp. Inf. Oolite, Bradford Abbas, Dorset. Collected and given to me by Rev. G. F. Whidborne. (P. 271.)

12, 12 *a*, *b*. *Terebratula maxillata*, Sow. Inf. Oolite, Rodborough. Collected and given to me by Rev. F. Smithe. (P. 264.)

13, 13 *a*, *b*. *Waldheimia reversa*, S. S. Buckman. Inf. Oolite, Bradford Abbas, Dorset. Coll. of Mr. S. S. Buckman. These figures are added in order to complete the illustration of the same shell in Pl. XIX. (P. 267.)

14, 14 *a*. „ *subnumismalis*, Dav. An abnormal form of the species from the *A. spinatus* zone, Middle Lias, Churchdown, Gloucestershire. Collected and given to me by the Rev. F. Smithe. (P. 270.)

15. „ *anglica*, Oppel. A very large example. Inf. Oolite, zone of *Am. Murchisoni*, Corton, near Sherborne. Coll. of Mr. E. Cleminshaw. (P. 270.)

16, 16 *a*, *b*. *Terebratula*, sp. Inf. Oolite, zone of *Am. Murchisoni*, Corton, near Sherborne. Coll. of Mr. E. Cleminshaw. (P. 265.)

17, 17 *a*. „ *curvifrons*, Oppel. A very large and fine example. Inf. Oolite, zone of *Am. Murchisoni*, Corton, near Sherborne, Dorset. Coll. of Mr. E. Cleminshaw. (P. 264.)

18, 18 *a*, *b*. *Koninckella liasiana*, Bouchard, sp. 18. Nat. size. 18 *a*, *b*. Enlarged. Middle Lias, Cymbium zone, Chideock. Coll. of Rev. G. F. Whidborne. (P. 278.)

19. *Discina Gunnii*, Dav. Inf. Oolite, Hocknorton Railway Cutting (Banbury and Cheltenham Railway), seven miles south-west of Banbury. Coll. of Mr. T. Beasley. (P. 279.)

CARBONIFEROUS SPECIES.

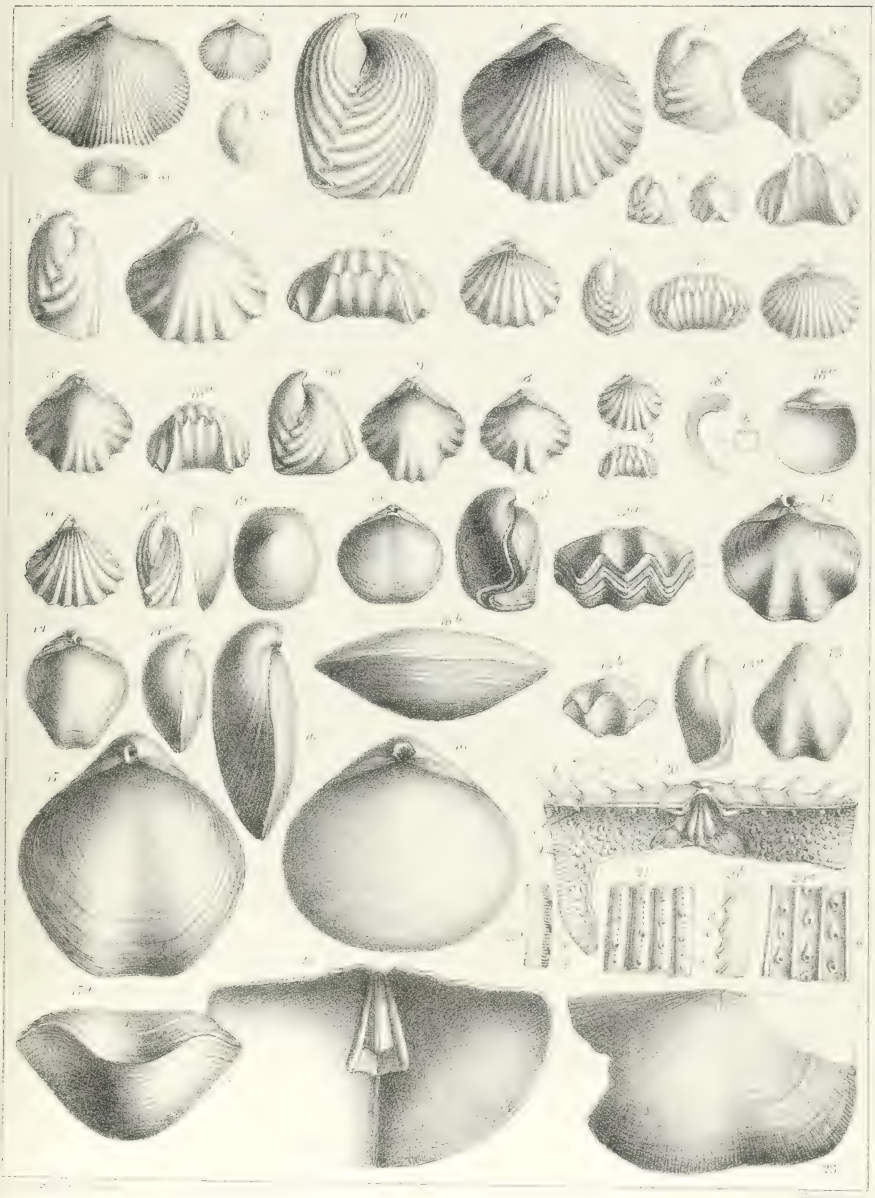
20, 20 *a*, *b*, 21, 21 *a*. *Chonetes Laguessiana*, De Koninck. 20. Part of the interior of ventral valve, enlarged, showing a row of tubular hollow spines on the cardinal edge, that open with round orifices on the inner surface of the shell. The tubes on the area shown by etching of the surface of the area, at first converging towards the beak under the surface of the area, but on arriving at the outer edge being prolonged as spines, and bending suddenly in the opposite direction. This specimen was prepared by Mr. John Young, F.G.S., of the Hunterian Museum, Glasgow. 20 *a*. Inner perforations between the ribs, considerably magnified. 20 *b*. Vertical section showing the perforations directing themselves towards the beaks, and passing through a very small portion only of the thickness of the shell. 21. Outer surface of the shell, when slightly etched, showing the larger perforations due to spines and minute perforations on the surface of the ribs. 21 *a*. Vertical section, showing minute perforations, *f*, and spine pores, *e*. Carb. shales, Capel Rig, East Kilbride, Scotland. (P. 280.)

22. *Aulacorhynchus Davidsoni*, Barrois. After Barrois. Interior of ventral valve, showing muscular impressions. Carb. limestone, Villayana, Spain. Given here as the species occurs in Great Britain, and is described in my 'Carb. Mon.' under the name of *Chonetes concentrica*, De Koninck. (P. 283.)

DEVONIAN SPECIES.

23. *Leptæna irregularis*, Roemer. Middle Devonian, Lummaton, near Torquay. Coll. of Mr. A. Champernowne, F.G.S. (P. 285.)

JURASSIC. CARBONIFEROUS. DEVONIAN.



APPENDIX TO SUPPLEMENTS, PLATE XXI.

FIG.

1. Lateral view of the viscera of *Waldheimia Australis*, after Hancock ('Phil. Trans.,' vol. 148, 2nd part, pl. lvii, fig. 2, 1858). *a*, Lateral view of the viscera:—*a*, dorsal surface of animal; *b*, ventral ditto; *c*, *c*, anterior wall of perivisceral chamber; *d*, brachial spiral, the left lateral portion of the arm having been removed; *d'* right lateral portion of ditto; *e*, great brachial canal; *f*, small or efferent ditto; *g*, brachial grooved ridge; *h*, sheath of transverse portion of calcareous loop; *i*, *i*, dorsal extremities of anterior and posterior occlusors; *j*, ventral portion of ditto; *k*, divaricators; *k'*, accessory ditto; *k''*, extremities of ditto attached to cardinal process; *l*, *l*, portions of ventral adjustors; *l'*, *l'*, portions of dorsal ditto; *m*, peduncle; *n*, peduncular capsule; *o*, peduncular muscle; *p*, œsophagus; *q*, stomach, with the roots of the biliary ducts exposed, the left lobes of the liver having been removed; *r*, right lobes of the liver seen through the dorsal mesentery; *s*, intestine; *t*, portion of gastro-parietal band; *t'*, central ditto; *u*, ventral mesentery; *u'*, upper portion of ditto; *v*, right oviduct, the left one is almost entirely removed; *w*, heart; *x*, dorsal pallial artery; *y*, ventral ditto; *y'*, blood sinus in mesenteric membrane; *z*, œsophageal ganglia. (P. 320.)

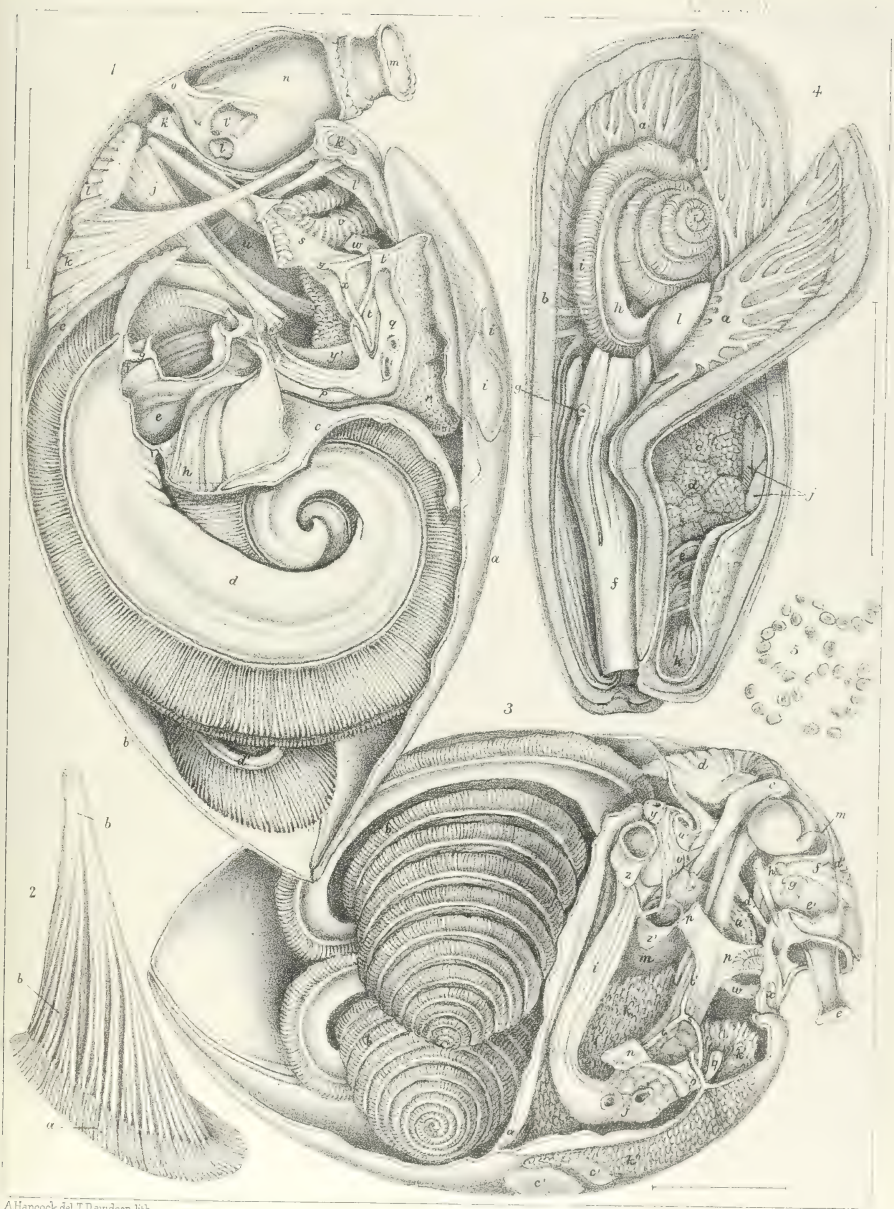
2. Ventral extremity of anterior occlusor of *W. Australis*, after Hancock. *a*, fleshy contractile portion; *b*, *b*, white tendinous ditto.

3. Side view of the viscera of *Rhynchonella psittacea*, after Hancock ('Phil. Trans.,' vol. 148, pl. lxi, fig. 2). *a*, anterior wall of perivisceral chamber; *b*, *b*, brachial organs; *c*, ventral terminations of occlusor muscles; *c'*, *c'*, dorsal terminations of anterior and posterior occlusors; *d*, *d*, divaricators, the left one cut through; *d'*, ventral wall of perivisceral chamber; *e*, peduncle; *e'*, capsule of ditto; *f*, peduncular muscle; *g*, one of the dorsal adjustors; *h*, one of the ventral ditto; *i*, œsophagus; *j*, stomach, exhibiting the two openings of the left hepatic ducts, the liver having been removed from this side; *k*, right lobes of the liver; *k'*, posterior lobe; *k''*, anterior ditto; *l*, dorsal mesenteric membrane; *m*, *m*, ventral ditto; *n*, lateral gastro-parietal band; *o*, central ditto; *p*, *p*, ilio-parietal bands; *q*, heart; *r*, branchio-systemic vein; *s*, aorta; *t*, *t'*, dorsal and ventral pallial or genital arteries; *u*, right ventral oviduct; *u'*, portion of left ditto cut through; *v*, œsophageal ganglia; *w*, sheath of crural process or oral lamina; *x*, orifice leading into ditto; *y*, portion of ditto of the opposite side; *z*, terminal sac of the left great brachial canal; *z'*, ditto of the right or opposite arm, seen through the mesenteric membrane. (P. 331.)

4. View of the pallial chamber of *Lingula anatina*, the ventral pallial lobe turned back, after Hancock ('Phil. Trans.,' vol. 148, pl. lxiv, fig. 3). *a*, ventral lobe; *b*, dorsal ditto; *c*, *c*, great pallial sinuses; *d*, *d*, lateral branches of ditto; *e*, *e*, puckers of lateral branches, occasioned by contraction of the pallial margin; *f*, *f*, terminal extremities of lateral branches; *g*, *g*, central branches of the great sinuses; *h*, marginal fold; *i*, a few of the setæ; *j*, extreme pallial margin; *k*, brachial apparatus; *l*, *l*, cirri; *m*, brachial fold; *n*, mouth; *o*, *o*, external orifices of oviducts. (P. 326.)

5. A few eggs of *Terebratulina septentrionalis* (after Morse) in their natural position, from pallial membrane of an adult individual.

RECENT.



A.Hancock del. T.Davidson lith

Hanhart imp

THE

PALÆONTOGRAPHICAL SOCIETY

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MDCCCLXXXIV.

MONOGRAPH

ON THE

LIAS AMMONITES

OF

THE BRITISH ISLANDS.

BY

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PART SEVENTH—DESCRIPTION OF SPECIES.

PAGES 441—480; PLATES LXXVIII—LXXXVII.

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Affinities and Differences.—*Harpoceras Levisoni* has strong affinities with *Harp. bifrons*, still the build of the shells presents important points of difference. In *Harp. Levisoni* the shelly laminæ are thicker, and the style of costation different; the lateral groove which divides the costæ on the sides, and produces an outer costated half and an inner smooth half in *Harp. bifrons*, is absent in *Harp. Levisoni*. The form of the siphonal area is likewise different, in *Harp. bifrons* we have a small keel with grooves on each side, whilst in *Harp. Levisoni* there is a thicker and more prominent keel, and an absence of the two lateral furrows on each side of the carina.

The morphology of the two species is likewise different. In early life the shell of *Harpoceras Levisoni* likens it to that of an *Arietites;* it has thick, straight costæ, knobbed at the angle, and a siphonal area with stout keel, and two lateral grooves, like *Ariet. obtusus;* all these characters, however, become obsolete as the evolution of the shell proceeds. It is only by breaking up large specimens and finding the nucleus, that the truth is revealed. When all these differences in the structural characters are fairly considered, they are sufficient to justify the separation into two distinct species.

HARPOCERAS EXARATUM, *Young and Bird.* Pl. LXII, figs. 1, 2, 3.

AMMONITES EXARATUS,	*Young and Bird.*	Geological Survey of Yorkshire Coast, p. 266, 1828.
— COMPLANATUS,	*d'Orbigny* (non *Bruguière*).	Paléontol. Française, Terr. Jurass., p. 353, pl. 114, 1842.
— EXARATUS,	*Simpson.*	Monogr. of the Ammonites, p. 32, 1843.
— —	—	Fossils of the Yorksh. Lias, p. 72, 1855.
— SUBPLANATUS,	*Dumortier.*	Dépôts Jurassiques, partie iv, p. 51, pls. x and xi, fig. 1, 2, 8, 1874.
HARPOCERAS EXARATUM,	*Tate and Blake.*	Yorksh. Lias, p. 305, pl. ii, fig. 5, 1876.

Diagnosis.—Shell discoidal, depressed, carinated, extremely involute, volutions three-fourths concealed; outer whorl in height about half the diameter of the disc. Costæ numerous, broad, distinct, simple, uniform, twice bent, and separated by neatly-cut sigmoidal grooves; sides of the whorls convex in the middle, inner margin sloping towards the spiral line. Siphonal area narrow; keel sharp, prominent, and entire; aperture elongated, lateral lappets short, slightly convex; abdominal spine prolonged. Umbilicus narrow, with its walls forming a re-entering angle.

Dimensions.—Transverse diameter 95 millimètres; height of the last whorl 45 millimètres; width of the aperture 21 millimètres; width of the umbilicus 18 millimètres.

Description.—*Harpoceras exaratum* is a well-defined and very abundant form in the Upper-Lias jet rock on the Yorkshire coast, where some large and beautiful shells are

sometimes found. Confusion has been introduced into the history of this Ammonite in consequence of d'Orbigny having mistaken this shell for *Ammonites complanatus*, Bruguière, which is a different species and not well defined by its author "*Ammonites striis simplicibus undulatis obliquis, sulco utrinque intermedio carina acuta,*" Bruguière, 'Encycl. Méthod.,' tom. i, p. 38. This diagnosis applies equally to two distinct forms; *a*, those in which the keel is not separated from the sides, and forms only the continuation thereof, and *b*, those in which the area shows three carinæ with two intermediate sulci. The first form has *Harp. exaratum* for its type, the second has *Am. bicarinatus*, Münster (in Zieten), for its type. D'Orbigny's pl. 114, figs. 1, 2 is an admirable delineation of *Harpoceras exaratum* and perfectly in accordance with a very good figure given by Chapuis and Dewalque under the name *Am. complanatus*. In *Harp. exaratum* the shell is discoidal, depressed, carinated, and extremely involute, the volutions concealing three fourths of the whorls, and the height of the outer whorl about one half the diameter of the disc; the radii are numerous, always biflexed and simple, appearing as if etched out with a graver, as expressed by the name, and extended upon the keel, which is not separated from the sides, of which it is only a continuation, and upon which they are prolonged in a marked manner. The very numerous radii parting from the spiral junction first incline forward, then bend backward, and again sweep forward in such a manner as to describe a sickle-shaped curvature; and, as they are all simple, it follows that the radii stand wide apart around the siphonal area, and are closely set together in a very regular form near the spiral angle (Pl. LXII, fig. 1). The umbilicus is narrow and deep with an angular margin without being trenchant, and the inner edge of each whorl overhangs part of the next whorl; this form of the spire permits a much larger portion of the inner volutions to become visible than would have been the case had the margin inclined outwards instead of inwards. The overhanging of the whorls constitutes a difference between *Harp. exaratum* and *Harp. bicarinatum*. In *Harp. bicarinatum* the inner sides of the whorls are vertical or nearly so.

The evolution of *Harp. exaratum* is well shown in two or three specimens collected by me in one mass from the jet-rock. One of the shells is only 21 millimètres in diameter, yet the sides are well ribbed with prominent radii, and there is a small carina on the siphonal area; the proportions and ornamentation of the young shell are clearly similar to those of the larger specimen found with it in the same mass of stone.

D'Orbigny united with his *Am. complanatus* the *Am. bicarinatus*, Zieten, and stated (p. 355) that the young shells of *Am. complanatus* show a tricarinate siphonal area, and he figured in his pl. 114, fig. 3, a small *Am. bicarinatus* in support of his assertion. In this the learned author was mistaken, as the young shell of *Harp. exaratum*, which is identical with his *Am. complanatus*, has only a single carina in the area. In fact, *Harp. bicarinatum* is a distinct form, for from its flattened sides and square area two small lateral carinæ arise on each side of the keel; three specimens before me from Milhaud, Aveyron, support this determination.

Dumortier has figured and described an Ammonite under the name *Am. exaratus*, which is very different from Young's typical shell; this is either a defaced specimen or another form. The plates which I consider to contain good figures of *Harp. exaratum* are those given by d'Orbigny, pl. 114; Dumortier pl. x and xi, figs. 1, 2; and the medium-sized shell drawn in Pl. LXII, figs. 1—3, in this work. The late Dr. Reynès in his 'Monographie des Ammonites,' Marseille, 1879, pl. iv, "Ammonites du Lias supérieur," figs. 4, 5, 6, gave admirable delineations of this species under the false name *Am. elegans*, Sow.

Affinities and Differences.—The *Falciferi* of Von Buch, whilst truly one of the most natural families of the Ammonoida, is at the same time one of the most difficult to differentiate into specific forms. Mere descriptions without carefully drawn and accurate delineations are in a great measure valueless, hence the confusion which exists in testing several of the species of this group. The difficulty an author experiences in detecting mistakes is very great, unless he has a set of good type specimens to refer to for comparison; seeing so much depends on the shape of the whorl, the style and diameter of the ribbing, the amount of involution, the inversion, eversion, or verticality of the spiral angle, the structure of the keel, the contouring of the suture-line, and the form of the appendages of the aperture; and so closely balanced are all these points with each other that without an actual comparison of typical specimens mistakes of identity are readily made.

Harpoceras exaratum closely resembles *Harp. serpentinum* in general outline, but differs in the following details :—The sides are more convex, the whorl is higher, the involution greater, the umbilicus narrower, and the sigmoidal valleys between the radii are much more sharply defined; the longitudinal sulcus also so characteristic of *Harp. serpentinum* is absent.

Harp. exaratum differs from *Harp. bicarinatum*, Münster; in the latter the sides are flatter, the area squarer, with a low keel and two lateral carinæ on the boundaries of the area; the involution is likewise greater, and the radii broader, less numerous, and very falciform (see Pl. LXXXII, figs. 9, 10, 11).

Harp. exaratum resembles *Harp. Lythense;* but in the latter the outer whorl is higher, the ribs fewer, larger, and rounder; the umbilicus narrow, the spiral angle very acute, and the sides of the walls vertical, exposing all the inner volutions; the aperture is sagittate, the upper portion sloping away toward the keel.

Locality and Stratigraphical Position.—This fine Ammonite, which sometimes attains 210 millimètres in diameter, is found in the zone of *Harp. serpentinum*, Upper Lias, at Whitby, Yorkshire.

Harpoceras Lythense, *Young and Bird*, Pl. LXII, figs. 4, 5, and 6.

Ammonites	Lythensis,	*Young and Bird.*	Geol. Surv. Yorksh. Coast, p. 267, 1828.
—	—	*Phillips.*	Geology of Yorkshire, pl. xiii, fig. 6, 1829.
—	—	*Simpson.*	Monogr. of Lias Ammonites, p. 33, 1843.
—	concavus,	*d'Orbigny.*	Terr. Jurass., p. 358, pl. 116, 1842.
—	Lythensis,	*Oppel.*	Juraformation, p. 24, 1856.
—	—	*Quenstedt.*	Der Jura, p. 248, tab. xxxv, fig. 5, 1858.
—	—	*Dumortier.*	Dépôts Jurass., partie iv, p. 56, pl. xi, figs. 9, 10, 1874.

Harpoceras Lythense, *Tate and Blake.* Yorksh. Lias, p. 304, pl. ii, fig. 4, 1876.

Diagnosis.—Shell stout, discoidal, depressed, and carinated; volutions four or five, nearly concealed; outer whorl in height exceeding the semi-diameter of the disc, thicker near the inner margin (which is acute, with rectangular walls), and sloping towards the outer margin, which terminates in a thick keel; inner half of the whorl longitudinally depressed and almost smooth, outer half sloping from a ridge towards the siphonal area, and covered with strong, obtuse, bent radii, which vanish on the side of the area; umbilicus narrow, with deep sides, rising stair-like from a sunken pit-like depression; aperture high and compressed, acute towards the margin, and deeply grooved by the return of the spire.

Dimensions.—Transverse diameter 95 millimètres; height of last whorl 50 millimètres; height of aperture 50 millimètres; breadth 23 millimètres; width of umbilicus 17 millimètres.

Description.—This is a well-known, and highly-characteristic species of the Upper-Lias beds near Whitby, which has been sadly misrepresented by bad figures. It may truly be said that Mr. Gawan's delineation of *Harp. Lythense* is the first accurate representation of the Yorkshire type. D'Orbigny, under the false name *Am. concavus*, figured a French shell obtained from the Upper Lias, which he identified with Sowerby's *Am. concavus*; this was a grave mistake, as the *Am. concavus*, Sowerby, is a very different shell, belonging to the *Harp.-Sowerbii* zone of the Inferior Oolite. I have no doubt therefore that the subject of d'Orbigny's figure is a true *Harp. Lythense*, which differs little from the typical form which this species assumes in the Yorkshire beds, and of which I have selected a very fine average specimen for the beautiful figure in Pl. LXII, figs. 4—6.

This shell is stout, depressed, discoidal, and carinated; the whorls are deep and extremely involute, the outer whorl exceeding in height the semi-diameter of the disc; on the inner half of the whorl there is a slightly depressed, longitudinal space, which near the middle rises into a low ridge, whence to the margin the side slopes away to the area, and forms a good character of the species; the keel is strong, but often absent, as the syphon lies safely buried in the mould of the shell; the keel is formed by a continuation of the sides, and is separated from them by a slight lateral depression. The

ribs, from fifty to sixty in number, are sigmoidal in form, feebly developed at the inner half of the whorl, and strongly developed on the external half from the low ridge outwards; they are here broad, flattish waves of the shell, with undulations of a similar breadth between. The shell-structure is very well shown in one of my specimens, in which the outer and inner laminæ are freely exposed; the outer lamina has rather a coarse texture, whilst the inner lamina is thin and smooth. The inner margin or spiral angle is very acute, and, as Young so well expressed it, "the interior edge of each whorl being rectangular, the central part appears like a small round pit with perpendicular sides." The aperture is elongated and compressed; and in one of my specimens the mouth is preserved, the sides of the aperture have two convex lappets, which correspond to the forward curve of the ribs, and there is an abdominal projection produced by the forward flexion of the costæ; in fact, here, as in all the other congeneric forms, the shape of the walls of the aperture is derived from the form and direction of the radii.

The suture-line is very complicated and not satisfactorily shown on any of my Yorkshire specimens. Professor d'Orbigny, who figured this structure, says that the siphonal lobe is narrower and shorter than the principal lateral and consists of one branch; the siphonal saddle is very large and divided unequally into two portions by a long accessory lobe, the external portion is much shorter and smaller than the other; the principal lateral lobe is large and provided without and within with five branches independent of the terminal branch. The lateral saddle is much narrower than the principal lateral lobe, and is divided into two equal parts; the other saddles are very irregular, the inner lateral lobe resembles the principal lateral in form, but is not more than one third its size, and the three auxiliary lobes are very small.

Affinities and Differences.—Professor d'Orbigny has given capital figures of this Ammonite, but committed a mistake in identifying it with Sowerby's species *Am. concavus*, which is an Inferior-Oolite shell belonging to the zone of *Harp. Sowerbii*, hence the confusion that has followed in the lists of species special to different beds; *Ammonites concavus* being quoted by some as a leading fossil of the Upper Lias, though it is known to those acquainted with its true form that it is never found out of the zone *Harp. Sowerbii* of the Inferior Oolite. *Harpoceras Lythense* is a thicker shell, strongly ribbed on the outer half of the whorl and slightly so on its inner half. *Harp. concavum* is a much thinner shell, with feeble costæ on the outer side of the whorl and nearly a smooth surface within. In *Harp. Lythense* the umbilicus is encircled by an acute angle, and the whorls are cut into vertical walls, whilst in *Am. concavus* the umbilicus is a concave cavity formed by a sloping away of the angles of the whorls. *Harp. Lythense* has a distinct and prominent keel, *Am. concavus* has no keel, but the siphonal area is bevelled away on each side, like the roof of a house.

Locality and Stratigraphical Position.—*Harpoceras Lythense* is collected at Whitby from the Upper Lias in beds of a shaly clay belonging to the zone of *Harpoceras serpentinum*. It was at one time common, but has now become rare.

HARPOCERAS OVATUM, *Young and Bird.* Pl. LXIII, figs. 4, 5, 6, 7.

AMMONITES OVATUS,		*Young and Bird.*	Geological Survey, p. 251, pl. xiii, fig. 4, 1822.
—	—	*Phillips.*	Geology of Yorkshire, pl. xiii, fig. 10, 1829.
—	—	*Simpson.*	Monogr. of Lias Ammonites, p. 35, 1843.
—	—	—	Fossils of the Yorksh. Lias, p. 76, 1855.
HARPOCERAS CÆCILIA,		*Reinecke.*	Tate and Blake's Yorksh. Lias, p. 305, pl. ii, fig. 6, 1876.

Diagnosis.—Shell discoidal, compressed, and carinated; whorls ovoid, one half involute; radii sigmoidal, bifid, each feebly-developed stem divides into two branches, of which from fifty to sixty are found on the convex side of one volution; the inner margin slopes evenly down to the penultimate whorl without any spiral angle; keel sharp, prominent, and entire, having two narrow shallow grooves on each side thereof. Aperture ovate, sides with convex lateral lappets, and a short projecting abdominal spine.

Dimensions.—Transverse diameter 105 millimètres; height of the last whorl 40 millimètres; width of umbilicus 29 millimètres; height of aperture 28 millimètres; width 23 millimètres.

Description.—This is a well-marked form in the Upper-Lias beds near Whitby; it often occurs as a rough, irregular-formed, discoidal, compressed shell, having ovoid whorls, which are one half involute; the inner third of the whorls slopes gently down to the spire without any angular margin such as is seen so well marked in *Harp. exaratum, Harp. Lythense,* and *Harp. elegans;* the sides of the whorls are, in fact, nearly convex in a regular well-formed shell, sometimes, however, the inner third of the whorl protrudes beyond the convex curve; the ribs arise by a number of feeble striæ from the inner margin, which soon coalesce and form stems, and each soon divides into two branches; the ribs are all twice bent, first a little forward, then well bent backward, and, lastly, again well directed forward; the radii are not prominent (Pl. LXIII, fig. 4).

The shell slopes away to the siphonal area, which is the narrowest portion of the volution. The keel is sharp, narrow, entire, and prominent, with two small longitudinal sulci on each side of it, on which the forward directed portion of the ribs finally vanish (Pl. LXIII, fig. 6).

The aperture is oval, and the walls form two lateral convex lappets and a forward-directed abdominal spine; just before the aperture the walls of the shell become slightly expanded, and show irregular foldings (Pl. LXIII, figs. 4, 5).

The suture line is of the *radians* type. The siphonal lobe is large, with two widely-diverging branches, and is nearly the size of the siphonal saddle, which is provided with an accessory lobule that divides the space into two unequal folioles, the inner one being the largest. The principal lateral lobe is very large; it has three lateral denticles on each side, and a long terminal branch; the lateral saddle likewise ends in two folioles,

with several leaf-like cells on the sides. The inner saddle is constricted in the middle, and surrounded by numerous folioles on the sides. There are three thick auxiliary lobes, and three narrow saddles between them, where they disappear under the spiral suture. The suture line is seen *in sitú* on Pl. LXIII, fig. 4, and an enlarged drawing of it is carefully drawn in Pl. LXIII, fig. 7.

Affinities and Differences.—Harp. ovatum is distinguished from the other congeneric species by its ovoid whorls without vertical or concave folds at the inner margin, by having a prominent keel with two lateral sulci, and by being provided with only faint sigmoidal radii, every two springing from a common stem. This species more closely resembles *Harp. radians* than any of the other forms with which it is associated in the Upper Lias of Yorkshire.

Locality and Stratigraphical Position.—This species appears abundant in the jet-rock and hard shales of the Upper Lias near Whitby and Runswick; it is rather an abundant fossil, but most of the examples are very rough and deformed; it is rare, therefore, to find so good an example as the one which I have figured as a type of the species.

HARPOCERAS ELEGANS, *Young and Bird*, Pl. LXIII, figs. 1—3.

	AMMONITES ELEGANS, *Young and Bird* (non *Sowerby*).	Yorksh. Coast, p. 267, pl. xiii, fig. 11, 1828.
—	CANDIDUS, *d'Orbigny*.	Terr. Jurass. (no description), pl. 63, 1842.
—	ELEGANS, *Simpson*.	Monogr. of the Lias Ammon., p. 31, 1843.
—	— —	Fossils of the Yorksh. Lias, p. 72, 1855.

Diagnosis.—Shell discoidal, compressed, subcarinated; whorls slightly convex, two-thirds involute; spiral angle acute, with a concave slope on the penultimate whorl; inner third concave, outer two thirds slightly convex; siphonal area narrow, sloping, with an elevated ridge in the middle; radii simple, sigmoidal, well marked in young shells, and becoming very delicate with age; aperture elongated and sagittate, with two slightly prominent lateral lappets.

Dimensions.—Transverse diameter 100 millimètres; height of the last whorl 38 millimètres; width of umbilicus 24 millimètres; height of aperture 27 millimètres; width 20 millimètres.

Description.—This is another common Whitby Ammonite which has hitherto been badly drawn, as shown in pl. xiii, fig. 11, of Young and Bird's work. Some authors refer this Ammonite to *Ammonites elegans*, Sow., but none of the specimens I have examined correspond with Sowerby's figure, which does not appear to be a Lias shell at all; as I have not seen the type specimen I refrain from further criticism. The figure which approaches nearest to this fossil is that given by d'Orbigny in his pl. lxiii, under the name

Ammonites candidus, d'Orb., 'Lias supérieur,' but oddly enough the author has omitted to give any description of his plate, nor does he make any allusion to it either in the text of his great work 'Paléontologie Française,' or in his 'Prodrome Paléont.;' I believe, however, in the identity of the *Am. candidus*, d'Orb., with *Harp. elegans*, Young.

The elegance of this Ammonite and the persistency of its beautiful lines long attracted my attention, and I have collected many examples from the jet-rock and hard shale of the Upper Lias near Whitby, where it was at one time a very common species. The specimen I have figured is a very good type of this form. The shell is thin and very well preserved in the figured specimen, which displays the structure of the radii in the shelly laminæ itself, and the impressions they leave upon portions of the mould exposed to view.

The shell is discoidal, compressed, and subcarinated. The keel does not form a distinct prominent elevation, but is a protruding ridge rising from the middle of the siphonal area, and is formed by the union of radii from the two sides joining together along the mesial line; the inner third of the whorl is slightly concave, and the outer two thirds convex and sloping upward into the keel. Some authors describe this species as possessing a sharp, prominent, entire keel, which does not agree with the foregoing description, so it is right to state that my definition applies to specimens which have the shell-structure preserved entire, whilst in other specimens in which the mould only exists the keel is much more distinct. The inner or spiral angle is acute and elevated (Pl. LXIII, fig. 1), and slopes inwards in a concave curve towards the penultimate whorl. The umbilicus, although narrow, is much exposed by the successive slopes of the inner volutions of the spire.

The shell thin, smooth, and shining, is ornamented on the sides in younger specimens by moderately prominent sigmoidal ribs, which gradually become less defined in older specimens, and finally degenerate into the very fine radii on the body-chamber.

The aperture is narrow, elongated, and sagittate; it has short, convex, lateral lappets, and a prolonged abdominal spine, with a thickening of the shell around the aperture.

The mould of this species, when entirely denuded of its shell, has a very smooth, shining appearance, and the very characteristic concave sloping of the inner margin of the whorls, already noted, is now more conspicuous, so that it is readily distinguished from its congeneric associates by this character alone.

Affinities and Differences.—It differs from *Harp. Lythense* in having narrower whorls and smaller ribs in youth, and by wanting them in age. The sloping concave character of the inner margin of the spire in *Harp. elegans* forms a marked contrast to the acute spiral angle and vertical marginal wall of the umbilicus in *Harp. Lythense.*

It differs from *Harp. exaratum* by the absence of the well-marked regular sigmoidal ribs and deeply grooved valleys possessed by that species, and by the want of the concave marginal slope of the whorls, which forms so good a diagnostic character; this also distinguishes it from *Harp. Lythense*, and it is equally good as a diagnostic trait of character between *Harp. elegans* and *Harp. exaratum.*

Harp. elegans is nearly related to *Harp. ovatum;* the latter, however, has convex

whorls without the spiral angle and concave slope seen in the former. *Harp. ovatum* has also a distinct prominent keel with a shallow groove on each side.

Locality and Stratigraphical Position.—This species is collected from the jet-rock and hard shales of the Upper Lias near Whitby and Runswick. Some very well-preserved specimens are found in the ironstone nodules abounding in these strata.

HARPOCERAS RADIANS, *Reinecke*. Pl. LXIV, figs. 1—7; Pl. LXXIV, figs. 1, 2; Pl. LXXXI, figs. 4, 5, 6.

NAUTILUS RADIANS, *Reinecke*. Nautil. et Argonaut., figs. 39, 40, p. 71, 1818.
AMMONITES — *Zieten*. Versteiner. Würtemb., p. 5, tab. iv, fig. 3, 1830.
— — *Roemer*. Norddeutschen Oolithgebirg, p. 185, 1836.
— — *d'Orbigny*. Pal. Franç., Terr. Jurass., t. i, p. 226, pl. 59, 1843.
— — *Quenstedt*. Flözgebirg. Würtembergs, p. 270, 1843.
— — — Cephalopoden, p. 110, t. vii, fig. 4, 1849.
— — *Chapuis et Dewalque*. Mém. Cour. Acad. Roy. Belgique Foss. Luxembourg, p. 72, pl. xi, fig. 1, 1854.
— — *Oppel*. Juraformation, p. 247, 1856.
— — *Quenstedt*. Der Jura, p. 281, table 40, figs. 13, 14, 1858.

Diagnosis.—Shell discoidal, compressed, carinated with a wide umbilicus; spire formed of six volutions, depressed, slightly convex on the sides, of a regular elliptical figure, and covered with from sixty to eighty round ribs, slightly prominent, always flexed, and simple from the umbilicus upwards; siphonal area narrow with a prominent keel, well separated from the ribs, much elevated, and persistent in its form.

Dimensions.—Pl. LXIV, fig. 1. Transverse diameter 115 millimètres; width of umbilicus 42 millimètres; height of aperture 30 millimètres; width of aperture 20 millimètres.

Description.—The species of Ammonites composing the Radians group are closely related to each other and require to be carefully studied at different periods of growth to ascertain their affinities and differences with other congeneric forms, and also to differentiate the species. The type of the *Am. radians*, Reinecke, fig. 39, is a well-defined form; the shell discoidal, compressed, and carinated, has a wide umbilicus, the spire is composed of six volutions, which are nearly one half involute; the whorls are gently convex, and a transverse section of the outer whorl gives a fairly elliptical figure. There are from sixty to eighty simple, blunt, biflexed radii on the last whorl, which extend singly from the spiral suture to the area without bifurcation. The keel is prominent, continuous, and entire, it is present in very young as well as in old shells, and is well separated from the flanks by a smooth or costate space, and in some varieties by a considerable width of the area. This shell appears to undergo very little change of form through life, a fact I have ascertained by breaking up several large Ammonites in order

to arrive at the truth. One small specimen, 5 millimètres in diameter, was costated and carinated like the outer whorl of the same species 40 millimètres in diameter. So that both the form, ornamentation, and figure are retained with very little change through life in this species. My learned friend, Professor Quenstedt, with his usual accurate eye for the discrimination of Ammonite forms, has described the following varieties of *Am. radians:*

α. *Radians depressus*, which is identical with *Ammonites striatulus*, Sowerby.

β. *Radians compressus*, resembling *Am. Capellinus*, Reinecke; its outer whorl is much higher than in *Am. radians depressus.*

γ. *Radians quadratus*, Quenst., of the type of *Am. radians depressus;* the keel has two lateral grooves on each side as in *Harp. bifrons.*

δ. *Radians costula*, Rein.

ε. *Radians comptus*, Rein., an intermediate form between Reinecke's *Ammonites radians* and Quenstedt's *Ammonites ammonius*, to which *Harpoceras opalinum* and *Harpoceras Murchisoni* appertain.

The septa are well displayed in figures 1 and 4, Pl. LXIV. They are symmetrical and are on each side divided into three lobes and three saddles, formed of single parts. The siphonal lobe is narrower and shorter than the principal lateral, and ornamented on each side with three digitations and two terminal divergent branches. The siphonal saddle is as large as the principal lateral lobe and divided by an accessory lobe into two unequal portions, the internal portion being the largest, and both terminate in many large unequal-sized folioles. The principal lateral lobe is large and ornamented on each side with five short and three elongated terminal branches, with numerous points to each branch. The lateral saddle is one third less than the principal lateral lobe and ends in large leaf-like expansions. The inner lateral lobe is not one half the size of the principal, its sides have several irregular digitations; besides these regular lobes there are two or three auxiliary lobes which are both short and irregular in figure.

The morphology of this species shows that at the diameter of 5 millimètres the keel and ribs were developed, the latter chiefly on the area first, afterwards appearing on the sides. At 24 millimètres diameter there were nearly forty ribs; at 43 millimètres diameter fifty-four ribs; at 70 millimètres diameter there were seventy ribs; and at 128 millimètres diameter the shell had ninety-four ribs, so that the number of the ribs of *Harpoceras radians* was in a direct ratio with the diameter of the shell. In the large German specimen, belonging to the British Museum Collection (Pl. LXIV, figs. 5, 6, 7), which attains 135 millimètres in diameter, there are ninety-six ribs.

Affinities and Differences.—*Harpoceras radians* very much resembles *Harp. serpentinum* both in form and ribbing. Its whorls, however, are not so high, and its ribs are only flexed and not bent in the middle; the sides are likewise convex, more involute, and not truncated at the inner border.

Locality and Stratigraphical Position.—This Ammonite attains a full development in

the *Lyt. Jurense* zone at Frocester Hill, from whence the shell drawn on Pl. LXIV, figs. 1—3 was collected; the large specimen, figs. 5, 6, 7, on the same Plate, was obtained from the equivalent horizon in Germany, the locality is unfortunately not recorded. I have a beautiful specimen from the Upper Lias of Somersetshire, depicted on Pl. LXXXI, fig. 4. Most of the examples of *Harpoceras radians* from Frocester and Nailsworth Upper Lias Sands are small, compressed, thick, stout shells.

HARPOCERAS STRIATULUM, *Sowerby*. Pl. LXXXIV, figs. 4, 5, 6.

AMMONITES STRIATULUS,	*Sowerby*. Min. Conchol., vol. iv, p. 23, tab. 421, fig. 1, 1823.
— LINEATUS,	*Schlotheim*. Petrefactenkunde, p. 75, No. 24, 1820.
— —	*Zieten*. Verstein. Würtembergs, p. 12, pl. ix, fig. 7, 1830
— STRIATULUS,	— Ibid., p. 19, pl. xiv, fig. 6, 1830.
— COMENSIS,	*Von Buch*. Petrif. remark, pl. ii, figs. 1—3, 1831.
— THOUARSENSIS,	*d'Orbigny*. Terr. Jurass., p. 222, pl. 57, 1842.
— RADIANS DEPRESSUS,	*Quenstedt*. Cephalopoden, tab. vii, figs. 4—6, 1849.
— COMENSIS,	*Chapuis and Dewalque*. Mém. Cour. Acad. Roy. Belgique, t. xxv; Fossil Luxembourg, p. 63, pl. ix, fig. 1, 1854.
— STRIATULUS,	*Simpson*. Fossils York. Lias, p. 87, 1855.
— —	*Oppel*. Die Juraformation, p. 248, 1856.
— —	*Dumortier*. Dépôts Jurassiques, partie iv, p. 64, pl. xvi, fig. 1, 1874.
— THOUARSENSIS,	— Ibid., p. 63, 1874.
HARPOCERAS STRIATULUM,	*Tate and Blake*. Yorkshire Lias, p. 308, 1876.

Diagnosis.—Shell discoidal, depressed, carinated; whorls about one third involute, convex on the sides; radii short; biflexed slender, vanishing from the inner third, thereby producing a smooth open umbilicus; siphonal area narrow, sloping towards the sides; radii terminate near the keel, which is small, trenchant, and bounded by two shallow sulci. Aperture elliptical; suture-line tortuous; septa wide apart.

Dimensions.—Transverse diameter 60 millimètres; width of the umbilicus 25 millimètres; height of aperture 18 millimètres; width of aperture 13 millimètres.

Description.—This Ammonite, evidently the *Am. radians depressus*, Quenst., and *Am. Thouarsensis*, d'Orbig., is easily distinguished from *Am. radians*, Reinecke, by the smooth inner portion of its convex whorls, from which the ribbing is absent, a character Sowerby failed to delineate in his otherwise good figure. The other point to which he attached so much importance, and upon which he founded the name *striatulus*, is seldom present, as the striæ only exist on the outer lamina of the shell which is seldom preserved. The baldness of the inner side of the whorl is a most persistent character, as the several specimens before me from different localities satis-

factorily prove. The shell is discoidal and compressed; the whorls about one third involute, are convex on their sides, and the outer two thirds of the height of each are ornamented with from forty to fifty short, slender, biflexed ribs; the inner third of the whorl, where it slopes towards the umbilicus is smooth, and from the summit of the slope the ribs commence; sometimes they are single, and sometimes they bifurcate, each stem dividing into two branches. The ribs first bend forward then backward, and again sweep forward towards the area and terminate at the side of a shallow sulcus, from which rises a thin prominent keel; the umbilicus is wide and the inner whorls are exposed, these have an ornate character as each whorl is smooth internally and ribbed externally. The aperture is either ovate or elliptical according to the amount of compression of the sides; the suture-line is well shown in many of my specimens, the chambers appear to have been large, as the septa are moderately distant from each other, and are composed of three lobes and three saddles with smaller auxiliaries. The siphonal lobe is as wide as but shorter than the principal lateral, and ornamented on each side with three short points and two single terminal branches. The siphonal saddle is one third larger than the principal lateral lobe, and divided into two unequal parts by an accessory lobe which arises from the concave surface, the whole ending in large folioles. The principal lateral lobe is large; it has two or three points on the sides and three longer terminal processes on the summit, and forms a conspicuous object on the side of the mould as it remains well apart from all the others. The lateral saddle is one third narrower than the principal lateral lobe, and terminates in two long folioles. The inner lateral lobe is about half the size of the principal and has an irregular figure with two or three small lateral points. The auxiliary saddle is wide, shallow, and trilobed, and the auxiliary lobes, two or three in number, are small and pointed, and pass into the ventral lobe, which is entirely concealed by the turns of the spire.

Affinities and Differences.—Some authors regard this species as the true type of *Harp. radians* and synonymous with it, I have, however, endeavoured to show the affinities and differences which exist between the two forms that lived together in the same sea abounding with congeneric species; still *Harp. striatulum* preserved the characters I have pointed out most persistently through life. And the same observation applies to the forms of this species recognised as *Am. Thouarsensis*, d'Orbig., and *Am. Comensis*, von Buch, in the respective French and German formations.

Locality and Stratigraphical Position.—I have collected this species from the dark Greyish Marl at Blea Wyke, near Robin Hood's Bay, associated with *Harpoceras variabile* and *Harp. insigne*, both characteristic fossils of the *Lyt. Jurense* zone. I have collected this shell likewise from the *Lyt. Jurense* Ammonite bed at Frocester Hill, Gloucestershire; these are the only localities I know in England. Sowerby's type specimen came from Blea Wyke, near Peak Hill, Robin Hood's Bay, Yorkshire, where it was collected by Mr. Crawford, of Scarborough, who sent the Ammonite to Sowerby; the specimen I have figured (Pl. LXXXIV, fig. 4) was collected by myself from the same locality.

HARPOCERAS INSIGNE, *Schübler*. Pl. LXV, figs. 1—6; Pl. LXVI, figs. 1—3.

AMMONITES INSIGNIS,	*Schübler* in Zieten, Verst. Würtemb., p. 20, tab. xv, fig. 2, 1830.
—	—	*Quenstedt*. Flözgebirge Würtemb., p. 272, 1843.
—	PHILLIPSII,	*Simpson*. Monog. Ammonites, p. 36, 1843.
—	INSIGNIS,	*Quenstedt*. Cephalopoden, p. 97, 1849.
—	—	*d'Orbigny*. Paléont. Française, Terr. Jurass., p. 347, tab. 112, 1842.
—	PHILLIPSII,	*Simpson*. Foss. of Yorksh. Lias, p. 78, 1855.
—	INSIGNIS,	*Oppel*. Die Juraformation, p. 250, 1856.
—	—	*Quenstedt*. Der Jura, p. 280, pl. 40, figs. 4, 5, 1858.
—	—	*Dumortier*. Dépôts Jurassiques, partie iv, p. 74, pls. xvii, xviii, 1874.
HARPOCERAS INSIGNE,	*Tate and Blake*. Yorkshire Lias, p. 310, 1876.	

Diagnosis.—Shell discoidal, depressed, and carinated; volutions six, one half involute; whorls convex on the sides, a row of tubercles developed at the angle near the inner margin, from which round fasciated ribs, slightly bent forward, proceed to terminate by the side of the carina; a short single rib lies in general between each pair of fasciated ribs; carina large, round, and not prominent; in youth and middle age the whorls are round; in large specimens the outer whorl becomes triangular, Pl. LXVI, fig. 2.

Dimensions.—The specimen figured on Pl. LXV, fig. 1, transverse diameter 133 millimètres; width of the umbilicus 53 millimètres; height of the aperture 40 millimètres; width 35 millimètres. This shell may be considered as a good typical example of the middle period of life of this species. By far the finest example of this species is that contained in the Museum of Geneva. The specimen was collected from the iron stone either of Thouars Deux-Sevres or of La Verpillière, and is figured in Pl. LXVI, figs. 1—3. Its dimensions are transverse diameter 290 millimètres; amount of involution two thirds the height of the whorl; the width of the umbilicus 100 millimètres; height of the aperture 114 millimètres; width of aperture near the base 110 millimètres. In this grand specimen the siphonal area forms a trigon, as is very well seen in the transverse section of the aperture.

Description.—I have figured three varieties of this Ammonite. Pl. LXV, fig. 1, I consider a good type form of this species during middle life. The shell is discoidal, the sides depressed, and the area supports a thick round keel, towards the sides of which the costæ approach and terminate (figs. 2, 3); the volutions, six in number, are one half involute, the sides are convex, and on the inner margin near the angle there is a row of round prominent tubercles, from each of which a fasciculus of round costæ, slightly inflected forward, pass over the sides toward the siphonal area, increasing in thick-

ness as they advance, and terminating abruptly by the side of the carina; the size and regularity of the tubercles, the straightness of the ribs, and the manner they end by the side of the thick round keel, distinguish this species from all other congeneric forms. When it attains a diameter of 120 millimètres the tubercles begin to disappear, the costæ fine down into depressed radii, and the keel becomes blunt and disappears, the outer whorl and the body-chamber change their form and become triangular, and the shell assumes a form which I have represented in Pl. LXVI. Just about the point where this metamorphosis takes place we notice on the mould a remarkable constriction, always in that portion of the shell where the septa are present; it is always unique, and never present before or after. At one time I was of opinion that the constriction might have been the result of an accident to the mollusk or to its shell during life; afterwards, however, I observed like constrictions in other specimens at the diameter of 120 millimètres, and hence it occurred to me that the Ammonite changed its lines of growth when it had attained that magnitude, just as we have a similar metamorphosis at a definite age in *Aegoceras heterogenum* of the Middle Lias. The two specimens delineated in Pl. LXV, figs. 1 and 4, show the constriction described, and a large imperfect specimen, 210 millimètres in diameter, from Heiningen, Würtemberg, in my collection, has a little mark on the mould at 120 millimètres diameter. In both the figured specimens referred to, the form of the whorl changes beyond the constriction; the whorls which up to that mark had been of a rounded or elliptical figure, begin henceforth to assume a distinctly triangular outline. In the beautiful and accurate plate of *Am. insignis* given by d'Orbigny (Pl. 112) this fact is very well represented, although nothing is stated in the text relating to the change of form by that most accurate observer, who appears to have had a large series of specimens illustrative of the morphology of *Harp. insigne*. On this subject our author states that "this species is without contradiction one of the most remarkable in reference to its changes of form according to the age and sex of individuals. An example of the diameter of 4 millimètres is entirely smooth, with a round back without keel. Another of a diameter of 5 millimètres presents some slight prominences around the umbilicus, and preserves them for some time without an indication of a carina. When the diameter has reached 10 millimètres the lateral costæ, the tubercles, and the carina become conspicuous. At the diameter of from 15 to 20 millimètres fourteen tubercles and thirty-two costæ can be counted. There are seventeen tubercles and thirty-eight costæ when the shell is of the diameter of 50 millimètres. A compressed specimen at the diameter of 125 millimètres showed thirty-four tubercles and eighty-four costæ. The period of degeneracy commences sooner or later according to individuals. With a diameter of 180 millimètres in bulky inflated specimens the tubercles sometimes cease; the ribs at 210 millimètres; the remaining portion being very smooth throughout."

I am able to supplement this account of the morphology of *Harpoceras insigne* by facts disclosed during the study of an interesting example of this Ammonite collected from the light-coloured marly beds of Upper Lias at Sheepscombe, near Painswick,

Gloucestershire. The diameter of this specimen is 225 millimètres. The body-chamber is not complete up to the aperture, although it has left indications on the mould showing the limits of its internal extent. The body-chamber occupies the whole of the last whorl. The shell of the body-chamber appears to have been quite smooth, the whorl is compressed and triangular, without carina and ribs, and on a portion of the penultimate whorl the ribs have vanished, and the carina has disappeared. The suture-line is so well preserved in the mould that it affords a safe guide for these observations.

Affinities and Differences.—This Ammonite resembles *Harp. variabile,* by the series of tubercles and fasciated ribs around the umbilicus. It is, however, a much thicker and less elegant shell, and the whorls are likewise more rotund and not so high, the keel is likewise much thicker and never attains the extreme elevation and remarkable structure seen in *Harp. variabile.* Its ribs are likewise less flexed and the siphonal area much broader in *Harp. insigne* than we shall find it to be in *Harp. variabile.*

Locality and Stratigraphical Position.—This Ammonite forms one of the leading fossils in the *Lyt. Jurense* zone in England. I have collected it at Frocester Hill, Sheepscombe, near Painswick, and at Ozleworth, all in Gloucestershire.

Foreign Localities.—In France it is a common species in the Upper Lias above the zone with *Harp. serpentinum,* and *Harp. bifrons.* According to Dumortier it is found at Saint-Cyr, Poleymieux, Saint-Fortunat, St. Romain, Limas, La Verpillière, Semur, St. Julien, St. Nizier, Charnay, Fressac, Mortiès, Vaux; Fevroux, Ain; Besançon, Thouars, Mort, Charolles, St. Quentin; and it is to be seen in the Museum at Lyons. In *Germany* it lies in the uppermost stratum of the Upper Lias, the zone of *Lyt. Jurense,* near Heiningen, Meiningen, Reichenbach, Hechingen, also near Uhrweiller-les-Vignes, Bas-Rhin.

HARPOCERAS VARIABILE, *d'Orbigny.* Pl. LXVII, figs. 1—6; LXVIII.

AMMONITES OBLIQUATUS, *Young and Bird.* Yorksh. Coast, p. 265, 1828.
— BEANII, *Simpson.* Ammonites York. Lias, p. 36, 1843.
— VARIABILIS, *d'Orbigny.* Paléontol. Française, p. 350, pl. 113, 1842.
— — *Chapuis et Dewalque.* Mém. Cour. Acad. Roy. Belgique; Fossiles du Luxembourg, t. xxv, p. 64, pl. ix, fig. 2, 1854.
— — *Oppel.* Die Juraformation, p. 250, 1856.
— DISPANSUS, *Lycett.* Trans. of the Cotteswold Club, vol. iii, p. 5, 1865.
— VARIABILIS, *Dumortier.* Dépôts Jurass., partie iv, p. 77, 1874.

Diagnosis.—Shell discoidal, compressed, carinated; volutions one half involute; sides convex, transversely costated; costæ sigmoidal, inflated towards aperture, and fasciated; fasciculi arise from a tubercle situated near the inner margin, in general a single

rib between the tubercles; siphonal area narrow, keel very thin and extremely prominent, distinct from the siphuncle; aperture compressed, sagittate, acute; suture-line tortuous, four lobed.

Dimensions.—Pl. LXVII, fig. 1. Transverse diameter 140 millimètres; width of umbilicus 45 millimètres; height of aperture 55 millimètres; width of aperture 27 millimètres.

Pl. LXVII, figs .3, 4, var. *dispansum.* Transverse diameter 85 millimètres; width of umbilicus 25 millimètres; height of aperture 35 millimètres; width of aperture 18 millimètres.

Pl. LXVIII. Transverse diameter 210 millimètres; width of umbilicus 75 millimètres; height of aperture 75 millimètres.

Description.—This beautiful Ammonite is one of the most dominant forms of the Lyt. Jurense-zone in Gloucestershire, from whence all the fine examples so accurately delineated in Pls. LXVII and LXVIII were collected. The shell is discoidal, much compressed and excessively carinated; the volutions, six in number, are one half involute; the whorls are ornamented with from sixty to seventy transverse sigmoidal costæ, all inflected towards the aperture; most of these are fasciated, and arise in pairs from well-marked tubercles developed around the inner margin, whilst others are short and single, and lie between the fasciated pairs; there is in general one simple rib between each fasciculus. The siphonal area is narrow (Pl. LXVII, fig. 2), in which the inflected costæ all terminate; from the centre arises a very narrow, extremely prominent keel (figs. 1, 2, 5, 6), which is rarely preserved, it stands straight out from the shell, and is situated outside and entirely distinct from the siphuncle (fig. 2), where it is well delineated. Here we observe that an accidental fracture of a portion of the shell has exposed some of the chambers and the siphuncle is shown *in sitû* beneath the outer lamina of the shell. The prominent calcareous carina has been entirely broken away from the area and was evidently independent of, and detached from, the siphuncle, which really lies embedded within the shell itself. In Pl. LXVII, figs. 3, 4 I have figured an example of the *dispansum* variety, from the sands at Frocester Hill. The sides are more convex and run out into a narrower area, with a thinner and sharper keel, the lateral costæ are smaller and more numerous, and the fasciated bundles less pronounced. The Ammonite described as *Am. Beanii,* Simp., is undoubtedly the same as d'Orbigny's *Am. variabilis,* and it was the discovery of this species in the Grey Marl, zone of *Lyt. Jurense* at the Peak, that settled the point as to the age of that bed with me. This species and *Harp. striatulum,* which I found associated together, proved that the Frocester Sands and the Grey Marls at the Peak were upon the same horizon of life.

The aperture is narrow, and elongated (Pl. LXVII, figs. 2, 6), and sometimes lanceolate, as in Pl. LXVII, fig. 4.

The suture-line is extremely tortuous, and in its contour developes four lobes and four saddles. The siphonal lobe is as wide but shorter than the principal lateral, and is

divided by the median line up to two fifths of its height, and on each side presents three points and one long terminal branch. The siphonal saddle is very wide, and divided by an accessory lobe at its termination into two unequal parts, the internal being the longest. The principal lateral lobe is large and pyramidal, and on each side has four lateral and two long terminal branches with many points. The lateral saddle is narrow, is divided by an accessory lobe into two portions, and terminates in from six to eight leaf-like expansions, but on a smaller scale than those found in the siphonal saddle. The inner lateral lobe is about half the size of the principal lateral, and is ornamented on each side with three branches, each terminating in a long slender filament. The auxiliary saddle is oblique and unequally divided, the external portion being the largest; it terminates in two lateral folioles and a terminal trifid foliole. The two auxiliary lobes are very unequal, the external is long, with lateral digitations; the inner much smaller, and develops only a sharp point. The radial line touches the points of the siphonal, inner lateral, and auxiliary lobes, and cuts the long terminal branches of the principal lateral lobe.

This species varies much in form at different periods of life. In youth the shell is thicker and more inflated, and the keel small or absent; afterwards both carina and lateral costæ are evolved, the marginal tubercles soon make their appearance, and the costæ assume the fasciated style they long maintain, until with advancing years the shell becomes flatter, the whorls more expanded, and the tubercles and costæ alike disappear from the surface. It cannot with justice be said, as d'Orbigny's name suggests, that its specific characters vary much: on the contrary, I consider that they are all well marked and stationary.

Affinities and Differences.—We discover two distinct varieties of *Harpoceras variabile*. The first (Pl. LXVII, figs. 1 and 5) may be considered as the type *a*, or *d'Orbignian* form, the second, *b*, (Pl. LXVII, fig. 3) I shall describe as the *Dispansian* form. The d'Orbignian form is found in the lower sands, whereas the Dispansion variety is found in the upper sands. This latter shell (Pl. LXVII, figs. 3 and 4) is much more discoidal, the keel more acute, the marginal tubercles smaller and more irregular, the costæ more delicate, sigmoidal, and fasciated. I have placed together on the same plate (LXVII), and side by side, the two forms into which the species ranges itself, and in Pl. LXVIII have figured one of the finest and largest shells I have ever seen of *Harp. variabile*, with all its shell preserved; it came from the upper sands. I shall here quote a passage from the paper of my old friend Dr. Lycett "On the Ammonites of the Sands between the Upper Lias and Inferior Oolite:"[1]

"*Ammonites dispansus*, Lycett. This was long confounded with *A. variabilis*, and it has only been after a comparison of very numerous specimens of both species, and of all stages of growth, that it has been found necessary to separate them; their geological position is also quite distinct, *A. dispansus* occurs only in the upper

[1] 'Proceedings of the Cotteswold Naturalists Field Club,' vol. iii, p. 5.

sands, *A. variabilis* does not pass higher than the lowest fossiliferous beds of the sands; both are very limited in their vertical range, and never occupy the same horizon. Both in the young and adult conditions of growth *A. dispansus* is always more discoidal than the other; the figure of the back more especially differs in its acute keel, the tubercles upon the inner margin of the volutions are much more faintly marked, and unlike those of *A. variabilis* they are irregular; they give origin to numerous fasciated sigmoidal radii; in *A. variabilis* the radii constitute rigid, nearly straight, and comparatively prominent ribs; the septa in *A. dispansus* have the lobes much more simple, less pointed, and less produced; the test is preserved very rarely and only in young specimens, it is delicate, and exhibits the fine hair-like sigmoidal radii much more distinctly than the casts. Specimens and fragments are very abundant at Frocester Hill; at Haresfield Hill they are present, but are badly preserved. The largest specimen in my possession is five inches and a half across, but very few exceed three inches."

Locality and Stratigraphical Position.—The type form I have collected from the sands between the Lias and Inferior Oolite near Bridport. The specimen (Pl. LXVII, figs. 1 and 5) came from that locality. The *Harp. dispansum* type (Pl. LXVII, figs. 3, 4) was collected at Frocester Hill and Pl. LXVIII near Nailsworth, Gloucestershire.

HARPOCERAS AALENSE, *Zieten.* Pl. LXXV, figs. 8—10; Pl. LXXX, figs. 1—3; Pl. LXXXII, figs. 1—4.

NAUTILUS COMPTUS? *Reinecke.* Naut. et Argon., p. 57, tab. 1, figs. 5, 6, 1818.
AMMONITES SIGMIFER? *Phillips.* Geol. of Yorksh., pl. xiii, fig. 4, 1829.
— AALENSIS, *Zieten.* Versteiner. Würtemberg, p. 37, pl. xxviii, fig. 3, 1830.
— RUGATULUS, *Simpson.* Fossils of Yorksh. Lias, p. 73, 1855.
— AALENSIS, *Oppel.* Die Juraformation, p. 248, 1856.
— MOOREI, *Lycett.* Cotteswold Hills Handbook, p. 122, pl. i, fig. 2, 1857.
HARPOCERAS AALENSE, *Tate and Blake.* Yorksh. Lias, p. 303, 1876.

Diagnosis.—a. Adult condition.—Shell discoidal, much depressed, carinated; whorls compressed, two fifths involute, inner border untruncated, sides slightly convex, closely covered with fine, simple, irregular striæ bent forward and inclined toward the carina, which is neither elevated nor distinct.

b. Young condition.—Striæ much larger, more unequal, distant, and distinct; siphonal area thinner and more trenchant; aperture narrow, elliptical.

Dimensions.—Large specimen, Pl. LXXX, figs. 1, 2 (= *Ammonites Moorei*, Lycett): transverse diameter 85 millimètres; height of whorl 30 millimètres; width of umbilicus 35 millimètres; width of aperture 15 millimètres.

Small specimen (Pl. LXXXII, figs. 1, 2, *Ammonites Aalensis*, Zieten) transverse

diameter 39 millimètres; height of whorl 16 millimètres; width of umbilicus 14 millimètres; width of aperture 9 millimètres.

Description.—This Ammonite has long been a puzzle to naturalists, seeing that the young shells agreed very well with Zieten's pl. xxviii, fig. 3, whilst the adult shells approached *Harpoceras opalinum*. I therefore, by the kindness of Professor Fraas, of Stuttgart, obtained some type specimens of *Am. Aalensis* collected from the Grey Marl of the Lias beds of Wasserelfingen near Aalen, from whence Zieten's type was derived, and on comparing these German specimens with a series obtained from the Ammonite bed of Frocester Hill, I found them to be identical with shells of the same size, and that the large shell which my late friend Dr. Lycett figured in his handbook as a new species under the name *Am. Moorei*, was in fact the adult condition of *Harpoceras Aalense*, Zieten (Pl. LXXV, fig. 9). In order to understand the history of this species we must study *Harp. Aalense* in its young and adult conditions (Pl. LXXXII, fig. 1, Pl. LXXX, fig. 1). In youth the radii are larger and wider apart, of unequal size, and always simple, the carina is acute and distinct, and the striæ are sometimes grouped in bundles together near the inner edge (Pl. LXXXII, fig. 1). When the shell reaches 30 millimètres in diameter an important change takes place; the striæ become smaller and more closely approximated, they cover the sides and pass over the carina in close apposition; the change from the large costæ of the young shell to the fine striæ of the outer whorl of the larger forms is very sudden, and affords a strong contrast, when seen within the umbilicus.

In the adult, so well figured in Pl. LXXX, figs. 1—3, and in Pl. LXXV, figs. 9, 10, the beauty and regularity of this species are well delineated. The shell is discoidal, much depressed, and carinated; the whorls are two fifths involuté; the sides covered with very numerous, small, single, biflexed striæ, which become hair-like and more closely set together in larger shells; so numerous are they, in fact, in the specimen I have figured, that they are counted with difficulty on the body-chamber. The whorls slope towards the previous volution, and are equally rounded towards the carina, which is not elevated or distinct from the area, and forms only its acute summit. The suture-line (Pl. LXXX, fig. 3) resembles that of *Harp. radians* (Pl. LXIV, fig. 4). The siphonal lobe is short and wide, it has several lateral digitations and two divergent terminal points. The siphonal saddle is wide, and divided by a small accessory lobe into two nearly equal spaces, which terminate in three folioles on each side. The principal lateral lobe is large; with three lateral digits on each side and two terminal points at its summit. The lateral saddle is small, and the inner lateral lobe, about one third the size of the principal, has a few digits on its circumference. The accessory saddle is a shallow space leading to two small auxiliary points.

The test of *Harp. Aalense* is very thin, and in general well preserved. The mould exhibits the form and direction of the radii in great perfection, better, in fact, than in those specimens which have retained their test.

Affinities and Differences.—*Harp. Aalense*, Ziet., resembles *Harp. radians*, Rein.; it

is, however, more compressed, the siphonal area more acute, without a distinct keel, and its fine, hair-like striæ pass over the ridge; the radii, likewise, are more unequal in size, and differ much during their evolution; the difference observed in the character of the radii in young and old shells forms another point of comparison which ought not to be omitted in treating of the affinities of this beautiful Ammonite, which is still more closely related to *Harpoceras opalinum*. A critical comparison of *Harp. Aalense* with *Harp. opalinum* will, however, be more in place in the article devoted to the description of that most interesting and beautiful form (p. 463).

The young forms of *Harp. Aalense* present a wide range of variability in the ornamentation of the shell, and it is only after the acquisition of a number of examples of genuine types, and a critical comparison of these with one another, that we realise the fact that we have first to learn the morphology of the species before we can study the varieties. In Pl. LXXXII, figs. 1—4, I have given accurate delineations of two examples of *Harp. Aalense* from the Lias beds of Wasserelfingen near Aalen, a deposit and locality from whence Zieten's type specimens were collected. These shells lead up, by a series of changes, from the young form (Pl. LXXXII, fig. 3) through a largely costated variety to a smaller costated form and up to a still finer ribbed variety which makes a transition link to the adult form presented by some of the smaller forms of *Harp. Moorei* (Pl. LXXX, fig. 1). Now, all these varieties I have in years past collected from the upper sands of Frocester Hill, and a few from a like bed at Nailsworth, Gloucestershire, and from Burton, Bradstock, and Chideock Hill, Dorsetshire. The English and the German varieties match each other so closely that we are bound to admit the forms mentioned are the necessary changes the organism has passed through in the evolution of the species.

Reinecke appears to have figured the young form with fine costæ under the name of *Nautilus comptus*, and Lycett a variety under that of *Am. Moorei*, whilst Zieten has figured the most typical shell (Pl. LXXV, fig. 8) as *Am. Aalensis*. In truth, all these forms are readily united by the intermediate links which one finds in a tray full of examples obtained from the Upper Lias Sands.

The variety "*Harp. comptum*" of Reinecke is in the young state distinguished by having fine, closely arranged, sigmoidal radii, which are fasciated at irregular intervals by folds of growth; subsequently the fasciated character disappears in older forms.

Locality and Stratigraphical Position.—Harpoceras Aalense is limited to the *Opalinum* zone of Frocester Hill and Nailsworth, and is found in the same horizon at Burton Bradstock and Chideock Hill, Dorsetshire. This Ammonite is a leading fossil in the upper part of the *Lyt. Jurense*-marl at Wasserelfingen near Aalen, and this same stratum has a wide distribution through Germany, as at Gundershoffen, and Uhrviller, Bas-Rhin; in France at Saint-Quintin, Isère, and the environs of Saint-Rambert, Ain; Saint-Romain, Rhône; and Verpillière, Isère, where magnificent specimens are obtained from the iron-stone bands.

HARPOCERAS COSTULA, *Reinecke*. Pl. LXXXII, figs. 5 and 6.

NAUTILUS COSTULA,	*Reinecke.*	Naut. et Argonaut, p. 68, tab. iii, figs. 33, 34, 1818.
AMMONITES COSTATULUS,	*Schlotheim.*	Petrefactenkunde, No. 33, p. 78, 1820.
— —	*Zieten.*	Versteiner, Würtemb., pl. 7, 1830.
— RADIANS COSTULA,	*Quenst.*	Cephalopoden, p. 113, t. vii, fig. 11, 1849.
— COSTULA,	*Oppel.*	Die Juraformation, p. 247, 1856.

Diagnosis.—Shell small, discoidal, compressed, carinated; whorls two thirds involute; sides covered with fifteen to twenty straight, prominent ribs, which occupy the inner two thirds of the whorl with wide, deep valleys between; area smooth with distinct, elevated, prominent keel; inner margin not truncated; aperture oblong.

Dimensions.—(Fig. 6) Transverse diameter 26 millimètres; width of umbilicus 8 millimètres; height of the last whorl 10 millimètres; (fig. 5) transverse diameter 33 millimètres; width of umbilicus 8 millimètres; height of last whorl 11 millimètres.

Description.—This small shell belongs to the same horizon as the preceding species; it is always diminutive in size, seldom attaining more than one inch in diameter and exhibiting then a portion of the body-chamber. The shell is compressed; the whorls are more than two thirds involute, and the sides ornamented with from fifteen to twenty straight, prominent ribs, which occupy only two thirds of the inner side of the whorl, and leave the upper portion of the side and area smooth with a strong prominent keel standing in the centre of the area. The umbilicus is narrow, and the inner whorls smooth and without costæ. The aperture is oblong and much invaded by the return of the spire.

Affinities and Differences.—This Ammonite resembles some of the ribbed youthful forms of *Harp. Aalense;* still, the prominent ribs at wide intervals apart, with the keel entire and prominent, are characters that are wanting in the usual forms in *Harp. Aalense*.

Locality and Stratigraphical Position.—The specimen I have figured (Pl. LXXXII, fig. 5) was collected from the fine grey marl in the Kocher Thal, by Wasserelfingen, Würtemberg, associated with *Harp. Aalense* and *Harp. radians*, all forms that characterise the *Lyt. Jurense*-zone in Germany. The same form with less coarse ribs (fig. 6) occurs in the *Lyt. Jurense*-zone at Frocester Hill, where it has long been considered to be the inner portion of *Harp. Aalense*, with which it is found associated.

HARPOCERAS BICARINATUM, *Münster*. Pl. LXXXII, figs. 9, 10, 10*a*, 11.

AMMONITES BICARINATUS, *Münster*. In Zieten's Versteiner Würtemberg, p. 21, pl. xv, fig. 9, 1830.
— ELEGANS, *Sowerby*. Mineral Conchology, vol. i, p. 213, pl. 94, 1815.
— — *Phillips*. Geol. York., pl. xiii, fig. 12, 1829.
— COMPLANATUS, *d'Orbigny*. Paléontol. Française, Terr. Jur., p. 353, pl. 114, figs. 1—4, 1842.
— BICARINATUS, *Quenstedt*. Der Jura, p. 578, 1858.
— — *Dumortier*. Dépôt Jurassique, partie iv, p. 55, pl. xi, figs. 3—7, 1874.

Diagnosis.—Shell compressed; whorls broad, sides flattened and ornamented with simple, narrow, nearly equal, biflexed costæ, separated by well-marked sulcations; siphonal area obtuse, with a small, central, vertical carina raised on a flat, and two lateral ridges which bound the flanks and form therewith an acute angle; umbilicus narrow, with vertical walls; aperture compressed, elongated, subquadrate.

Dimensions.—Transverse diameter 49 millimètres; width of umbilicus 6 millimètres; height of last whorl 25 millimètres; width of aperture 12 millimètres.

Description.—This beautiful little Ammonite has occasioned much confusion in the description of the "falcifers" of the Upper Lias beds, in consequence of d'Orbigny having figured in his plate 114, fig. 3, a shell of *Am. bicarinatus* as the young shell of his *Am. complanatus*.

Harp. exaratum (*complanatum*, d'Orb.) has a round siphonal area and prominent keel (Pl. LXII, figs. 1—3), whilst *Harp. bicarinatum* has a flat area, small central keel, and two lateral ridges separating the area from the flanks. I have a series of four fine specimens from Milhaud, Aveyron, before me, which show this character very well. The specimen I have figured (Pl. LXXXII, figs. 9, 10) is the only English example I know. There is a neatness and angularity about the entire outline of this Ammonite which serve to distinguish it. Dumortier put this question to a crucial test, he broke up several large specimens of *Am. complanatus*, d'Orb., for the purpose of procuring their small interior whorls in order to compare them with true forms of *Am. bicarinatus*. The result of this comparative study convinced him that there was nothing to justify the union of the two shells, and that *Am. bicarinatus* was a good species, well separated by the form of its carina and whorls, which never varied, and that none of the examples of *Am. complanatus*, d'Orb., which he had obtained had shown a structure of the siphonal area similar to the one so accurately delineated in figs. 9 and 10, Pl. LXXXII.

The whorls are oval and the spire extremely involute, so that the last whorl occupies one half the diameter of the disc; the costæ arise by simple, hair-like stems around

the umbilicus, and widen as they pass singly over the sides, describing a double flexure thereon and terminating in the lateral ridge which bounds the area. The umbilicus is very narrow with vertical walls and shows all the inner whorls.

The suture-line is complicated (Pl. LXXXII, fig. 10 *a*); the siphonal lobe is short and narrow; the siphonal saddle very large, with a long oblique accessory lobe which divides the area into two spaces; the external is the smallest and its walls are incised by six or eight folioles; the internal is nearly as large as the principal lateral, and here are twelve folioles in the walls. The principal lateral lobe is very large and surrounded with ten long denticles; the lateral saddle is likewise large and the walls have many folioles; the external lateral lobe is much smaller than the principal, it has two side branched denticles, and a terminal tuft; the auxiliary lobes and saddles, four in number, diminish in magnitude from without inwards, and present nothing of interest before reaching the umbilicus.

This species exhibits abroad many varieties in its young state; some have the sides flattened and the area angulated, others have sides and area gracefully curved, some have the costæ delicate, regular, and closely arranged, others unequal and deep, with distant sulci between; hence these various forms have been mistaken for other species. In the adult condition, however, this Ammonite preserves a very uniform figure and ornamentation, and is a very characteristic fossil of the zone of *Lyt. Jurense*.

Locality and Stratigraphical Position.—The specimen figured (Pl. LXXXII, figs. 9, 10) belonged to the late Dr. Lycett who collected it from the Lower Sands near Nailsworth, it is now the property of the Museum, Geological Survey, Jermyn Street. Fig. 11, Pl. LXXXII, is copied from d'Orb., Pal. Franç. 'Terrains Jurassiques,' tom. i, pl. 114, fig. 3.

HARPOCERAS OPALINUM, *Reinecke*. Pl. LXXX, figs. 4, 5, 6, 7, 8.

NAUTILUS OPALINUS,	*Reinecke*.	Nautil. and Argonaut., p. 55, figs. 1, 2, pl. i, 1818.
— MÆANDRUS,	—	Ibid., p. 56, tab. 1, figs. 3, 4, 1818.
AMMONITES PRIMORDIALIS,	*Schlotheim*.	Die Petrefactenkunde, No. 8, p. 65, 1820.
— CARINATUS,	*Haan*.	Ammon. et Goniat., p. 139, 1825.
— PRIMORDIALIS,	*Zieten*.	Versteiner Würtemb., p. 5, tab. iv, fig. 4, 1830.
— OPALINUS,	*Quenstedt*.	Flözgebirge, p. 285, 1843.
— —	—	Cephalopoden, p. 115, tab. 7, fig. 10, 1849.
— PRIMORDIALIS,	*d'Orbigny*.	Paléont. Franç., Terr. Jurassiques, p. 235, tab. 62, 1842.
— OPALINUS,	*Quenstedt*.	Der Jura, p. 307, tab. 42, fig. 8, 1858.
— —	*Lycett*.	Proc. Cotteswold Nat. Club, vol. iii, p. 5, 1865.

Diagnosis.—Shell discoidal, compressed, and subcarinated; volutions six, two thirds involute; sides slightly convex or flattened, inner margin concave, outer margin

sloped into a trenchant, slightly prominent carina without a keel, over which fine striæ pass; test moderately thick, striated with many fine, falciform depressions, sometimes fasciated; siphuncle lies immediately beneath the carina, which envelopes it; aperture elongate, sagittate, with projecting lateral lappets, and a long abdominal spine; suture-line tortuous.

Dimensions.—Transverse diameter 115 millimètres; width of umbilicus 25 millimètres; height of aperture 50 millimètres; width of ditto, 24 millimètres.

Description.—This beautiful Ammonite characterises the uppermost stratum of the Liassic sands in Gloucestershire and Dorsetshire, where I have collected it *in situ*. In Germany this same stratum with *Lytoceras torulosum* is classified with the Brown Jura or Lower Oolite, but the English sections have induced me to place it with the Ammonites of the sands. I have taken a specimen at Haresfield in a block of rock with its impression on the Lower Oolite which rested immediately upon it, so high does it range.

The shell is compressed, discoidal, and strongly carinated, but without a distinct keel; the volutions, six in number, are about two thirds involute, raised a little in the middle, convex on the outer half, and slightly depressed on the inner. The whorls are likewise concave at the inner margin, where they embrace the umbilicus, and curve towards the siphonal area, where they form a trenchant carina without a distinct keel, producing an acute bevelled edge over which striæ pass from the right to the left side of the shell, as shown in Pl. LXXX, figs. 7 and 8.

The surface of the shell is ornamented with innumerable fine striations, rather unequal in size, biflexed in figure, and extending uninterruptedly from the umbilicus to the area. The striæ are sometimes fasciated at the inner margin from the clustering together of so many striæ into a limited space. In many shells this is wanting, but may be noted in the two fine examples (Pl. LXXX, figs. 4, 6). The aperture is compressed, elongated, and sagittate. The sides have, when perfect, long, narrow, lateral lappets and a projecting abdominal spine, all of which leave their impression on the mould of the body-chamber.

The suture-line is tortuous, and forms six lobes on each side. The siphonal lobe is shorter and as wide as the principal lateral, and ornamented on each side with two branches, of which the terminal one is bifid. The siphonal saddle is wide and divided into two portions by a long accessory lobe; the innermost is the widest and terminates in two complex and one simple foliole, the outer portion is long and narrow and develops several lateral folioles. The principal lateral lobe has a long, stout, straight stem, with three digitations on each side and three terminal branches. The lateral saddle is very symmetrical, and as large as the principal lateral lobe; it is divided into two parts by a short accessory lobe at the base, and the sides and bottom terminate in a number of rounded leaves. The inner lateral lobe is narrower and shorter than the principal lateral, and its sides and terminal portion develops many pointed digitations. The outer auxiliary saddle is rather large, developing a number of folioles; the first auxiliary lobe is a little smaller than the

inner lateral, and the other two auxiliaries are much smaller, with saddles of corresponding sizes (see Pl. LXXX, fig. 5).

Affinities and Differences.—This shell resembles *Harp. radians* (Pl. LXXXI, figs. 4, 5) in possessing biflexed striæ and a sharply carinated siphonal area, but is distinguished from that species by the absence of a distinct keel, and in having smaller and less prominent striæ on the sides, a much narrower umbilicus, and more numerous side-lobes in the septa. It still more closely resembles *Harp. Aalense* (Pl. LXXX, figs. 1, 2), from which it differs only in a very few particulars and these are as follows. The whorls are higher, they have always an angular and concave inner margin (Pl. LXXX, figs. 4, 6); the umbilicus is narrower; the inner whorls are almost entirely concealed, the striæ are more marked and flexed, and the side-lobes more numerous. *Harp. opalinum* and *Harp. Aalense* are doubtless very nearly allied forms, and which apart might be mistaken for each other, but when carefully compared the distinctions pointed out appear to be persistent. The carefully drawn delineations of *Harp. Aalense*, which I have given, and which I have placed on the same plate for comparison with those of *Harp. opalinum*, will aid the student in his diagnosis of *Harp. opalinum* and *Harp. Aalense* much better than words.

In reference to this species I annex the following remarks sent to me by the late Dr. J. Lycett:

"In my paper entitled 'Notes on the Ammonites of the Sands intermediate to the Upper Lias and the Inferior Oolite'[1] I have followed the example of all preceding palæontologists and arranged *Ammonites opalinus* as distinct from *Am. Aalensis*, Ziet. An examination of numerous Gündershöfen specimens of *Am. opalinus* has recently convinced me that the two supposed species are identical, and that both are referable to varieties of *Ammonites Aalensis* described in the paper above referred to.

"In the course of the twenty years which comprise my experience of collecting at Frocester Hill, it has often been a matter of surprise to me that no specimen of *Am. opalinus* should have rewarded my endeavours, and that only some two or three examples should have been obtained by other collectors at that locality; it now appears that some examples of the variety of *Am. Aalensis* termed by me *Moorei* differ from Gündershöfen specimens in no feature of any importance, and that the greater envelopment of the volutions exhibited by the majority of the foreign specimens is by no means persistent even in them, the Cotteswold specimens exhibiting much variability in this respect, some few of the more depressed forms having the volutions much enveloped, and acquiring some degree of angularity upon the inner slopes of the volutions, as is more commonly seen in the Gündershöfen shells; nor are instances wanting in the latter wherein the radii become large, distant, irregular, and unequal in size, thus constituting the variety '*Aalensis*;' upon the whole, however, the Gündershöfen specimens of all sizes do not exhibit so considerable a variability in the figure and ornamentation as is

[1] 'Proceedings of the Cotteswold Nat. Club,' vol. iii, p. 1, 1865.

seen in the Frocester Hill shells, and we miss the two varieties with obtuse backs and distant radii which constitute the varieties '*costula*' and '*regularis*;' perhaps, however, these deficiencies might also disappear upon examining good Swabian collections. The septa are identical both in Swabian and Cotteswold shells, the observer should, however, be careful to examine both sides of the Gündershöfen specimens, as in one now before me the septa of the right side exhibit a singular abnormal change from the true design, which, however, is perfect upon the left side, and the general figure of the shell has nothing peculiar; this variability does not occur in Frocester Hill shells.

"Quitting the examination of specimens I will now advert to the literature of the species; the first figure and description is that of the '*Nautilus*' *opalinus* of Reinecke. Quenstedt, in his several works, has figured forms of the variety '*Moorei*' with the volutions much enveloped as *Am. opalinus*, and has also given examples of *Aalensis* and of *costula* as distinct species. D'Orbigny, in his 'Palćontologie Française,' has figured an aged shell resembling the variety '*Moorei*,' but unusually inflated, as *Am. candidus*, afterwards changed to *Am. primordialis* upon an erroneous idea that it was the species figured under that name by Schlotheim. Upon another plate he has figured both young and aged examples of the allied species *Am. Aalensis*, which are very truthful in all the details of their ornamentation; a comparison of the septa figured by him of the two supposed species which are taken from some of the last-formed chambers of aged shells will show that in both the pattern and the design are the same, and that the differences are of the most trifling description, if these, indeed, are not attributable to the artist; the descriptions of *Am. primordialis* and *Am. Aalensis* are also substantially alike, if in both we may use the word costa and striæ. The author in question makes no reference to the *Am. opalinus*, Reineck."

Locality and Stratigraphical Position.—This Ammonite is entirely limited to the uppermost bed of the *Harp.-opalinum* zone. I have collected it only in these localities: Frocester, Haresfield, Gloucestershire; and at Burton Bradstock and Chideock Hills, Dorsetshire.

HARPOCERAS DISCOIDES, *Zieten*. Pl. LXXXII, figs. 12, 12*a*, 13.

AMMONITES DISCOIDES,	*Zieten*.	Verst. Würts., p. 21, pl. xvi, fig. 1, 1830.
—	—	*d'Orbigny*. Paléontol. Française, Ter. Jurass., p. 356, pl. 115, 1842.
—	—	*Oppel*. Die Juraformation, p. 245, 1856.
—	—	*Quenstedt*. Der Jura, p. 283, pl. 40, fig. 7, 1858.

Diagnosis.—Shell compressed, carinated; whorls broad, nearly entirely involute; sides compressed, slightly convex, and covered with biflexed sulcated undulations; umbilicus nearly occluded; siphonal area narrow, lanceolate, and slightly serrated; aperture very deep, broad at the base, and narrowly lanceolate at the outer border.

Dimensions.—Transverse diameter 70 millimètres; height of the last whorl at aperture 38 millimètres; transverse width at thickest part 15 millimètres; height of aperture 35 millimètres; width of umbilicus 5 millimètres.

Description.—This is a very rare Ammonite in the Cephalopoda-bed of Frocester, and the specimen I have figured is the largest I have collected; it agrees so well with Zieten and d'Orbigny's figures that there is no doubt about the identity of the species.

The shell is much compressed, strongly carinated, and provided with a very small keel. The whorls are broad and the last exceeds in depth more than half the diameter of the disk, so that the shell is extremely involute with a very small umbilicus. The sides are ornamented transversely with simple, equal, biflexed costæ, which spring separately from the circumference of the umbilicus, and gently and gracefully bend forward, then incline backwards, and afterward shoot forward towards the outer border, the costæ are separated by shallow sulci which have a similar curve to the costæ (Pl. LXXXII, fig. 12).

The siphonal area is narrowly lanceolate, and provided with a short and slightly prominent keel. The spire is composed of compressed whorls which are angular towards the umbilicus and trenchant at the border, the umbilicus is very narrow with declining walls. The aperture forms an acute angle, rounded at the base (fig. 13). The suture-line is very complicated, and as none of my specimens show the beautiful lines of this structure, I have copied d'Orbigny's capital figure of the same. The chambers are symmetrical and divided on each side into nine lobes and nine saddles formed of single parts.

The siphonal lobe nearly as long and much wider than the principal lateral lobe, is provided with four branches; of these the inferior branch is very large and oblique. The siphonal saddle, twice as large as the principal lateral, is divided into two large unequal-sized branches, of which the internal is the widest, with a very large

accessory lobe. The principal lateral lobe, large and oblong, is adorned on each side with five ramified branches, not including the terminal branch. The lateral saddle, nearly as large as the principal lateral lobe, is surrounded by nine folioles. The auxiliary lobes are seven in number, the first is large and the inner six rapidly diminish in size as they approach the umbilicus and are separated by as many small saddles with foliated walls. A radial line extended between the siphonal lobe and the umbilicus would pass beneath all the other lobes.

Prof. d'Orbigny[1] had the opportunity of examining a young form of *Harp. discoides*, he says at the diameter of 5 millimètres it has a smooth, round, siphonal area, which soon becomes angular but remains smooth up to a diameter of 10 or 11 millimètres. The simple transverse costæ and sulci afterwards begin to appear, and are nearly as equally spaced out as they are in the adult. Each additional whorl contains a greater number than the penultimate whorl, and thus the number of the costæ and furrows increases with the growth of the shell.

Affinities and Differences.—This species very much resembles *Harp. exaratum* in the width of the whorl, and in the flexures of the costæ, which in both are simple and distinct throughout, both have a small umbilicus with a similar involution of the whorls. In the siphonal area lies the difference, *Harp. discoides* has a sharp trenchant area, whereas in *Harp. exaratum* there is a central keel with two lateral furrows, and two outer carinæ bounding the area.

Locality and Stratigraphical Position.—I have collected three or four specimens of this shell from the Upper Sands at Frocester Hill in the zone of *Harp. opalinum*. The largest example I possess is the one now figured. In France it has been obtained from many localities where the *Harp.-opalinum* zone crops out as at Milhaud, Aveyron; near Fontenay, Vendée; Sant-Rambert, Ain; Uhrviller, Bas Rhin; near Lyons, near Salins, Jura; la Verpillière, Isère; Privas, Ardèche; Fressac, Gard; la Cride, Var; St. Fortunat, Rhône; St. Romain, Rhône; whenever this beautiful little Ammonite is found it may be considered to be a leading fossil of the *Harp.-opalinum* zone.

[1] 'Paléontologie Française, Terrains Jurassiques,' tom. i, p. 357.

HARPOCERAS ACUTUM, *Tate*. Pl. LXXXII, figs. 7 and 8.

Ammonites "falciferen," *Quenstedt*. Jura, p. 174, tab. xxii, fig. 31, 1858.
AMMONITES SERPENTINUS, *Beesley*. Geol. of Banbury, p. 10, 2nd ed., 1873.
— ACUTUS, *Tate*. Geological Magazine, decade ii, vol. ii, p. 204, 1875.

Diagnosis.—Shell discoidal, carinated, and compressed; whorls one half involute, sides convex, covered with numerous small, single, close-set, biflexed radii, which impart a neatness and compactness to the whorls; siphonal area convex, with a thick, prominent keel, inner side sloping gently to the spiral suture; aperture oval.

Dimensions.—Transverse diameter 31 millimètres; height of last whorl 13 millimètres; width of umbilicus 9 millimètres; height of aperture 12 millimètres; width of aperture 8 millimètres.

Description.—This neat little Ammonite was collected by my friend Professor Quenstedt near Dürnau, associated with *Am. globosus* in a bed of Lias equivalent to the zone of *Am. spinatus*. It was subsequently discovered in England by Mr. Beesley, F.G.S., and catalogued[1] as *Am. serpentinus* in his 'Sketch of the Geology of Banbury.' Its difference from the young forms of that species was, however, noticed by Professor Ralph Tate, who entered this Ammonite in his "Notes on some New Liassic Fossils,"[2] under the name *Ammonites acutus*. Our author writes:—"This species has some resemblance to, but is obviously distinct from, *A. serpentinus*. No specific name has yet been applied to the species represented by Quenstedt's figure, though one or two authors have sought to include it under certain new species described by them. *A. pseudo-radians*, Reynès makes a near approach to it, but the whorls are more embracing in the present species, which I call *A. acutus* on account of its sharp, elevated keel. As Sowerby's *A. acutus* is now recognised as belonging to *A. margaritatus*, the specific name is free to be re-applied."

This is certainly a very elegant little Ammonite belonging to the *radians* group, is remarkable for its small, thin, lustrous shell, and convex sides closely covered with simple, hair-like, bi-flexed striæ, which commence at the umbilicus, ascend over the sides, and pass over the thick, prominent keel, certainly large in proportion to so small a shell. The radii are very delicate in young shells, and become more prominent in those of larger growth, such as the specimen I have figured and enlarged two diameters. The umbilicus is narrow, and all the inner whorls are exposed. The aperture is ovate, and cut out below by the return of the spire.

Affinities and Differences.—*Harpoceras acutum* certainly belongs to the *radians*

[1] 'Sketch of the Geology of the Neighbourhood of Banbury,' 2nd ed., 1873.
[2] 'Geological Magazine,' decade ii, vol. ii, p. 204, 1875

group, and resembles an elegant form of that species observed in the passage-beds between the *Amaltheus-spinatus* and *Stephanoceras-commune* zones in Dorsetshire.

Locality and Stratigraphical Position.—Mr. Beesley collected his specimen at Adderbury. Mr. Edwin A. Walford collected those he kindly sent me for inspection from Chipping Warden, Northamptonshire, where it is associated with *Stephanoceras commune* and forms approaching *Stephanoceras crassum*.

HARPOCERAS NORMANIANUM, *d'Orbigny*. Pl. LXXXIII, figs. 1, 2.

AMMONITES NORMANIANUS, *d'Orbigny*. Paléontol. Française, Terr. Jurassiques, p. 291, pl. 88, 1842.

Diagnosis.—Shell compressed, carinated, bisulcate, and slightly involute; whorls compressed, convex in the middle, and flattened at the marginal and spiral sides, regularly costated transversely, with upwards of seventy simple biflexed radii with nearly equal sulci between. Siphonal area narrow; carina prominent, having a narrow groove on each side; aperture quadrate, compressed on the sides, and roundly angulated.

Dimensions.—Transverse diameter 85 millimètres; width of umbilicus 40 millimètres; height of aperture 25 millimètres; width 17 millimètres.

Description.—The Ammonite figured on Plate LXXXIII, figs. 1, 2, resembles *Am. Normanianus*, d'Orb., more closely than any other that has passed through my hands. It has the same number of simple costæ equally biflexed, a like amount of involution, but in addition it has two small lateral grooves on each side of the carina which are absent in d'Orbigny's type shell; how far this may be a variable or persistent character is unknown.

Locality.—I found this specimen in one of the cases of the British Museum with the MS. name I have retained; the shell was numbered, but the locality from whence it had been collected was not mentioned. Judging from the petrology of the matrix it appears to be Middle Lias.

The existence of the small, bell-shaped Aptychus in the body-chamber induced me to have the specimen figured.

Family.—AEGOCERATIDÆ—*continued*.

Genus VII.—STEPHANOCERAS. *Waagen*, 1869.

Family—CORONARII,	*Von Buch.*	Abh. könig. Akad. Wissensch. Berlin, Ueber Ammoniten, p. 145, 1832.
CORONATEN,	*Quenstedt.*	Cephalopoden, p. 175, 1849.
PLANULATI,	*Pictet.*	Traité de Paléontologie, t. ii, p. 693, 1854.
CORONATI,	*Seebach.*	Hannoversche Jura, p. 147, 1864.
Genus—PERONOCERAS (*pars*),	*Hyatt.*	Foss. Cephalopods; Bulletin of the Museum of Comparative Zoology, Harvard's College, Cambridge, Mass., vol. i, p. 85, 1863—1869.
DEROCERAS (*pars*),	—	Ib., p. 84.
DACTYLIOCERAS (*pars*),	—	Ib., p. 95.
STEPHANOCERAS,	*Waagen.*	Formenreihe, Benecke's Beitr., ii, 247, 1869.
—	*W. Neumayr.*	Zeit. Deutsch. Geol. Gesellschaft, Bd. lxxvii, p. 915, 1875.

The general form of the shell in the genus *Stephanoceras* is very variable; the siphonal area is in general large and round without keel, border, or channels, and the sculpture is often highly ornamental. From the umbilical suture rises a short stout rib which often ends in a tubercle at the middle or upper part, from which spines project as in *Steph. Deslongchampsii* (fig. 202); from the tubercle two or three smaller costæ pass over the area and unite with their fellows from the opposite side. Sometimes the tubercles are absent, and a number of fine encircling costæ complete the sculpture, as seen in *Stephanoceras commune* and

FIG. 196.—*Stephanoceras commune.*

FIG. 197.—*Stephanoceras annulatum.*

FIG. 198.—*Stephanoceras Braikenridgii.*

in *Stephanoceras annulatum* in which the style of costation just described is very well shown.

The border of the aperture is encircled either by a broad band as in *Steph. commune*, or lateral lappets are produced and inflected as in *Steph. Braikenridgii*, in which they are often conspicuous and well preserved (figs. 198 and 199). In *Steph. Blagdeni*, *Steph. Humphriesianum*, and *Steph. Deslongchampsii* the mouth is encircled with a broad band. The body-chamber varies from one half to one and a quarter whorls in length. The suture-line is much ramified. The siphonal and principal lateral lobes are nearly of equal length; the inner lateral is much smaller and there are several auxiliary branches.

FIG. 199.—*Stephanoceras Braikenridgii.*

FIG. 200.—*Stephanoceras Blagdeni.*

FIG. 201.—*Stephanoceras Blagdeni.*

FIG. 202.—*Stephanoceras Deslongchampsii.*

Many characteristic species appear for the first time in the Upper Lias, as *Steph. commune*, *Steph. annulatum*, *Steph. crassum*, *Steph. fibulatum*, and *Steph. subarmatum*. The zone of *Steph. Humphriesianum* in the Inferior Oolite is a great depository of the species of this genus both in England and in France. In this horizon we find—

Stephanoceras	*Braikenridgii*, Sow.	*Stephanoceras*	*Deslongchampsii.*
—	*Brocchii*, Sow.	—	*Gervillii*, Sow.
—	*Brongniarti*, Sow.	—	*Humphriesianum*, Sow.
—	*coronatum*, Brüg.	—	*Sauzei*, d'Orb.
—	*Blagdeni*, Sow.	—	*linguiferum*, d'Orb.

The Aptychus is bivalved, calcareous, and very thin, and has upon its external surface numerous small granules.

The genus *Stephanoceras* appears to have certain near relations with the genus *Aegoceras* through the species *Aeg. pettos* of the Middle Lias (see p. 363).

The group represented by other Jurassic forms, as *Stephanoceras modiolare*, Luid., and *Stephanoceras macrocephalum*, Schloth., stands well apart from the more compressed forms of *Harpoceras* in the Upper Lias. All the varieties of the *Macrocephali* are globose from the extreme involution of the spire and the narrowness of the umbilicus; they also possess a remarkably complicated suture-line. This genus has very few forms in the European Jurassic rocks and occupies a limited horizon in them, commencing with *Stephanoceras macrocephalum* in the Cornbrash of England and

the equivalent horizon in Germany. Species of *Stephanoceras* are found also in the Kelloways rock and in the clay bed interposed between it and the dark clays at the base of the Oxfordian.

STEPHANOCERAS COMMUNE, *Sowerby*. Pl. LXXXIII, figs. 3—4; Pl. LXXXIV, figs. 1—3; Pl. LXXXVII, figs. 9, 10.

CORNU-AMMONIS,	*Lister*.	Hist. animal, Pl. vi, fig. 5, 1678.
AMMONITES COMMUNIS,	*Sowerby*.	Min. Conch., vol. ii, p. 10, pl. 107, fig. 3, 1815.
— ANGULATUS,	—	Ibid., vol. ii, p. 9, pl. 107, fig. 1, 1815.
NAUTILUS ANNULARIS,	*Reinecke*.	Nautil. et Argon., pl. vi, figs. 56, 57, 1818.
AMMONITES COMMUNIS,	*Keferstein*.	Catal., 1819.
— ANNULATUS,	*Schlotheim*.	Petref., p. 61, No. 2, 1820.
— ANNULARIS,	—	Ibid., p. 78, No. 32, 1820.
— COMMUNIS,	*Young and Bird*.	Yorksh. Coast, p. 246, pl. xii, fig. 3, 1822.
PLANITES BIFIDUS,	*Haan*.	Amm. et Goniat., p. 86, No. 13, 1825.
AMMONITES COMMUNIS,	*Phillips*.	Yorksh., p. 163, 1829.
— —	*Zieten*.	Versteiner. Würtemberg., p. 9, pl. vii, fig. 2, 1830.
— ANNULARIS,	—	Ibid., p. 14, pl. x, fig. 10, 1830.
— COMMUNIS,	*Simpson*.	Monogr. on Ammon., p. 18, 1843.
— —	*d'Orbigny*.	Pal. Fr., Terr. Jurass., p. 336, pl. 108, 1842.
— —	*Quenstedt*.	Die Cephalopod., p. 172, pl. xiii, fig. 8, 1846.
— —	—	Der Jura, p. 251, 1858.
STEPHANOCERAS COMMUNE,	*Neumayr*.	Zeitsch. Deut geol. Gesell., p. 916, 1875.
— —	*Tate and Blake*.	Yorksh. Lias, p. 299, 1876.

Diagnosis.—Shell discoidal, slightly compressed; whorls round and well costated on the area and sides; lateral costæ 50, straight and directed obliquely forward, at the side of the area they divide into two branches which arch forward over the area and unite with those from the opposite side. Aperture orbicular and slightly grooved, embracing the whorl.

Dimensions.—Transverse diameter 83 millimètres; height of last whorl 20 millimètres; width of last whorl 20 millimètres; width of umbilicus 48 millimètres.

Description.—Shell discoidal and slightly compressed; whorls feebly involute, round, and gently flattened on the sides; the latter covered with from forty-five to fifty sharp, narrow costæ, commencing at the spiral suture and ascending obliquely forward two thirds of their length, when they regularly bifurcate without a trace of tubercle, and pass over the siphonal area; one of the two loops passes entire, whilst the second is often not complete at the point of bifurcation. The whole of the costæ of the area describe arches,

the convexity of which are directed towards the aperture. The spire is composed of round whorls, a little higher than they are wide; in some varieties the whorls incline towards a quadrate section and embrace the penultimate whorl feebly so that this species is extremely involute. The aperture exhibits nearly a round or sub-orbicular section being hollowed out below to receive the return of the spire. In Pl. LXXXIII, figs. 3, 4, I have figured a specimen of *Stephanoceras commune* from the British Museum Collection which has the mouth aperture well preserved. There is first a circular constriction, and then a round, prominent band surrounding the aperture; there are no side lappets; and it is worthy of note that the mantle of the animal, when producing this termination, formed the simple rib on the side and bifurcate ribs which extend across the area. This specimen shows also that the dwelling chamber of *Stephanoceras commune* was very short and occupied little more than half the length of the last whorl of the shell. The suture-line (Pl. LXXXIV, fig. 3) forms three lobes and three saddles on each side. The siphonal lobe is long but wider than the principal lateral, and develops on each side four digitations terminating in two pointed processes. The siphonal saddle is much larger than the principal lateral lobe, and terminates in three unequal, trilobed folioles. The principal lateral lobe has an irregular figure, having three digits on each side and a terminal obtuse one. The lateral saddle is small and oblique, terminating in four unequal folioles. The inner lateral lobe is small and oblique, and terminates in two points, the auxiliaries are quite rudimentary.

Locality and Stratigraphical Position.—This Ammonite, as its name implies, is one of the most common fossils in the Upper Lias, and was at one time found in great numbers near Whitby, some parts of the beach at one time were literally paved with nodules containing them; in those days a cart load might have been had in a short time; the fossils were usually inclosed in nodules and it was for these the search was made, as the nodules were largely used in the manufacture of Roman cement; the demand having exceeded the supply, they are now no longer abundant.

Although this species is so common in England, Prof. d'Orbigny stated that he did not know it in France; however, since that time, Dumortier has figured a very good example from the Ironstone Sands at la Verpillière, Isère; where it is associated with *Stephanoceras annulatum*.

It is very commonly met with as a leading fossil in the Upper Lias strata of Northampton, Warwick, Gloucester, Somerset, and Dorset, and has a wide distribution in these counties.

STEPHANOCERAS ANNULATUM, *Sowerby*. Pl. LXXXIV, figs. 7, 8, 9.

NAUTILUS ANGUINUS,	*Reinecke*.	Nautil. et Argonaut., fig. 73, 1818.
AMMONITES ANNULATUS,	*Sowerby*.	Min. Conchol., vol. ii, p. 41, pl. 222, fig. 5, 1819.
PLANITES ANGUINUS,	*Haan*.	Amm. et Goniat., p. 89, 1825.
AMMONITES ANNULATUS,	*Young and Bird*.	Yorksh. Coast, p. 253, pl. xii, fig. 11, 1828.
— —	*d'Orbigny*.	Paléont. Franç., Terr. Jurass., p. 265, pl. 76, figs. 1, 2, 1842.
— —	*Simpson*.	Monogr. on Ammonites, p. 21, 1843.
— —	*Quenstedt*.	Cephalopoden, p. 173, tab. xiii, fig. 11, 1849.
STEPHANOCERAS ANNULATUM,	*Tate and Blake*.	Yorkshire Lias, p. 299, 1876.

Diagnosis.—Shell discoidal, compressed; whorls round, narrow, a little depressed on the sides, and slightly involute; costæ small, slender, flattened, annular, and very numerous, some simple, others bifurcate, and both alternate; siphonal area round, and truncated beneath for the return of the spire.

Dimensions.—Transverse diameter 80 millimètres; width of umbilicus 45 millimètres; height of aperture 20 millimètres; width of aperture 20 millimètres.

Description.—The shell of *Stephanoceras annulatum* presents a marked difference to the other forms of the *Steph. commune* group, like them it is discoidal and a little compressed on the sides; the whorls are narrow, round, and each revolution of the spire is ornamented with one hundred and thirty slender costæ, flat on the edge, and cut out as neatly and sharply from the shell as if they had been chiselled with a tool (Pl. LXXXIV, fig. 7); the costæ are all of the same size and directed obliquely forward, some are simple and annular passing over the area undivided like rings, whilst other bifurcate at the margin, so that the two forms alternate singly or doubly with one another. Considerable irregularity in this arrangement, however, is sometimes visible, and in those cases two or three simple costæ alternate with one bifurcate rib. In early life and up to a diameter of fifty millimètres, there was alternately one simple rib and a bifurcate rib encircling the area, with increased dimensions; when the shell had attained to eighty millimètres in diameter, the number of bifurcated ribs began to increase and the simple annular costæ to diminish. The umbilicus is widely open and exposes all the inner whorls of the spire, which consists of seven whorls a little higher than they are wide; all are slightly involute. The aperture is oval and only feebly grooved by the return of the spire.

Affinities and Differences.—*Stephanoceras annulatum* resembles *Stephanoceras commune* (Pl. LXXXIV, fig. 1), but is distinguished by its more numerous, slender ribs less

regularly bifurcated, more closely placed together and neatly cut as with a tool, and in addition by its annular, straight ribs which are not bent forward at the point of inflection.

Locality and Stratigraphical Position.—This species is found in ironstone nodules in the Upper Lias of Whitby in the zone of *Stephanoceras commune*.

STEPHANOCERAS FIBULATUM, *Sowerby*. Pl. LXXXV, figs. 5—11.

AMMONITES FIBULATUS,	*Sowerby*.	Min. Conchol., vol. iv, p. 147, pl. 407, fig. 2, 1823.
—	—	*Young and Bird*. Geol. Surv. York. Coast, p. 262, pl. xiii, fig. 9, 1828.
—	—	*Simpson*. Monogr. on Ammonites, p. 22, 1843.
—	ANDREÆ	— Yorkshire Lias, p. 59, 1855.
STEPHANOCERAS FIBULATUM,	*Tate and Blake*.	Yorkshire Lias, p. 301, 1876.

Diagnosis.—Shell discoidal, compressed; whorls round on the area, flattened on the sides, and slightly involute; spire entirely exposed; costæ numerous, united in pairs by a small, smooth tubercle near the outer margin, then split again into two or three arched costæ on the area where they join their fellows. Section of aperture subquadrate.

Dimensions.—Transverse diameter 85 millimètres; breadth of area 20 millimètres; height of aperture 22 millimètres; width of umbilicus 46 millimètres.

Description.—One of the most obvious characters in this very beautiful Ammonite is the uniting of the radii by knobs, like a button and loop; in some specimens this style is very uniform, in others modifications are observed; for example, in one shell two of the radii unite on the knob, and then a single rib passes up between them, bifurcates and extends over the area; in other examples three ribs are seen to be united. The whorls are flattened on the sides and ornamented with upwards of fifty sharp, oblique costæ (Pl. LXXXV, figs. 6 and 7) which commence at the spiral suture, ascend obliquely upwards and forwards to the border of the siphonal area, where a spiny tubercle is developed, from this point two small costæ arise and cross the area in an arched form, the convexity being directed towards the aperture. The siphonal area is round and highly ornamented by the ribs which cross it with great regularity. The costæ on the inner whorls are usually small, so that within the umbilicus the shell is in general fine-ribbed, presenting a marked contrast in this respect to the highly ornamented sides of the last whorl. Mr. Young, who had a large series of this species in his possession, says in his 'Survey of the Yorkshire Coast,' "Some of the inner whorls are marked with double ribs meeting in the knobs, and then parting into three on the back; and on the outer whorl or whorls, we find strong, single ribs, knobbed, each splitting into three beyond the knobbed towards the back. In some specimens, the ribs on the outer whorl are alternately knobbed and plain; in each case the

plain rib passes over the back undivided, while the knobbed rib parts into three. The double rib and knob resemble a button and loop, whence the name *fibulatus*, and sometimes the whole disk, from the margin of the back to the centre, is found marked in this style."

I have figured for comparison specimens showing the variation in the style of this species, a variety in which the side knobs are small (Pl. LXXXV, fig. 5), another (Pl. LXXXV, fig. 7) in which they are large and spinous, and another (Pl. LXXXV, fig. 8), which has received the name of *Andreæ ;* in fact, this Ammonite presents many modifications of its style of ribbing, but all the examples return into the loop and knob style so well described by Mr. Young. Pl. LXXXV, figs. 10, 11, is the var. *Stephan. Bollensis* of Quenstedt.

Affinities and Differences.—I have endeavoured to describe as accurately as possible the peculiar character of the ribbing in *Stephanoceras fibulatum*, seeing that it is in this character we discover the difference between it and *Stephanoceras commune*, and likewise the distinction between *Stephanoceras fibulatum* and *Stephanoceras subarmatum* with which it is very often confounded, as several specimens before me prove.

Locality and Stratigraphical Position.—This species is found in the Upper Lias at Whitby and Lofthouse, Yorkshire, in the zone of *Stephanoceras commune*.

STEPHANOCERAS SUBARMATUM, *Young*. Pl. LXXXV, figs. 1—4.

AMMONITES SUBARMATUS,	*Young and Bird.*	Geol. Surv. of Yorks., p. 250, pl. 13, fig. 3, 1822.
—	—	*Sowerby.* Min. Conchol., vol. iv, p. 146, pl. 407, fig. 1, 1823.
PLANITES	—	*Haan.* Ammon. et Goniat., p. 84, 1825.
AMMONITES	—	*Young and Bird.* Geol. Surv., p. 263, pl. xiv, fig. 8, 1828.
—	—	*Simpson.* Monogr. on Ammonites, p. 23, 1843.
—	—	*d'Orbigny.* Paléont. Fr., Terr. Jurass., p. 268, pl. 77, 1842.

Diagnosis.—Shell discoidal, thick, whorls subquadrate, involute; their width exceeds the height; transversely costated; costæ simple or fasciated; inner whorls develop spiny tubercles near the line of the spiral suture which are mostly absent in the last whorl; at the tubercle the costæ split and divide into two or three finer costæ which pass across the margin; area convex, flat, closely costated; aperture less in height than in width; section subquadrate.

Dimensions.—Transverse diameter 65 millimètres; height of aperture 20 millimètres; thickness 25 millimètres; width of umbilicus 30 millimètres.

Description.—The shell of this species is thick, discoidal and compressed; the

whorls are subquadrate, wider than high, and slightly involute, they are transversely ornamented with 36 to 42 small costæ which commence at the spiral suture and cover the sides, some remain single, whilst others unite in pairs and form a tubercle which develops a long outward directed spine; the tubercles and spines occupy the margin of the inner whorls and form a deep spiny umbilicus. On the outer whorl the tubercles begin to disappear, and the costation then consists of a simple bifurcate rib which sends its branches across the area. The siphonal area which is broad and flat, is closely adorned with small costæ derived from the fasciated tubercles, as well as from the intermediate simple ribs that pass freely and singly up the sides and over the area. The spire is formed of subquadrate whorls compressed in contact with each other and marked by the elongated spines that proceed from the tubercles along the line of the spiral suture. The aperture in section is subquadrate, and when the termination is preserved it is found to consist of a circular contraction and a round thickened band similar to the appendage I have figured as appertaining to *Steph. commune* in Pl. LXXXIII, fig. 3. The septa are symmetrical on each side, the principal lateral lobe is large and terminates in three large branches; the lateral saddle is narrower than the principal lobe and terminates in two large folioles of which the internal is the largest. The inner lateral lobe has an irregular figure terminating in two horn-like points.

Affinities and Differences.—I have figured two types of this Ammonite, the large tumid specimen (Pl. LXXXV, figs. 2, 3) from the Upper Lias of Chipping Warden, Northamptonshire. The specimen (Pl. LXXXV, fig. 1) with large knobs and fasciated costæ resembles a variety of *Stephanoceras fibulatum* from the Upper Lias at Whitby. This last specimen is not a satisfactory example, still it is the best I could obtain of the species at Whitby.

STEPHANOCERAS RAQUINIANUM, *d'Orbigny*. Pl. LXXXVI, figs. 5, 6, 7. Pl. LXXXVII, figs. 1, 2, 3, 4, 7, 8.

AMMONITES REQUINIANUS, *d'Orbigny*. Paleont. Fr., Terr. Jurass., p. 332, pl. 106, 1842.
— — *Chapuis et Dewalque*. Mem. Cour. Acad. Roy. Belgique, t. xxv, Foss. du Luxembourg, pl. vii, fig. 1, 1854.
— — *Quenstedt*. Der Jura, p. 251, 1858.

Diagnosis.—Shell discoidal; whorls tumid, one half involute, transversely costated; sides inflated, covered with short, straight ribs, twenty to thirty, commencing at the umbilicus, and half way up the side becoming tuberculated, fasciated, and

split up into two or three smaller costæ, which pass across the outer margin and join those of the opposite side. Siphonal area large and convex; aperture depressed, subquadrate.

Dimensions.—Transverse diameter 45 millimètres; height of last whorl 18 millimètres; width of umbilicus 15 millimètres; height of aperture 18 millimètres; width of aperture 19 millimètres.

Description.—The shell of this species is very thick; the whorls are one half involute and depressed, much wider than deep; the sides are inflated and costated, with from twenty-two to thirty-two short, straight ribs, which commence at the umbilicus and terminate at the lateral border of the siphonal area, either in a small blunt tubercle or a fasciation of the ribs; from these points two or three minute costæ pass across the area and unite with their fellows from the other side of the shell; besides the small costæ proceeding from the tubercles or fasciated group there are other simple costæ which pass between the ribs from the umbilicus and the area, and others between the costæ on the area and contribute to the increased costation which adorns the broad siphonal area of this beautiful form.

The siphonal area is very broad, depressed, and convex, and closely covered with fine transverse costæ. The spire, composed of depressed whorls, is wider than high, and embraces half of the preceding whorl. The aperture is semilunar and depressed, convex above and concave below, where it receives the return of the spire.

The septa are symmetrical, and form on each side two lobes of single elements and two large saddles. The siphonal lobe is as long and much wider than the principal lateral, and ornamented on each side with three branches, of which the lower one has five points. The siphonal saddle terminates in three unequally festooned folioles. The principal lateral lobe terminates in three branches, which are slightly digitate. The lateral saddle is neither so deep nor wide as the siphonal, and ends in four shallow folioles, divided by an accessory lobule; the auxiliary lobes are rudimentary.

Prof. d'Orbigny[1] investigated the morphology of this species, and found that at the diameter of 20 millimètres it possessed nineteen costæ; at the diameter of 35 millimètres it possessed twenty-seven, but at the maximum height it had forty-eight. The Professor stated also that in youth it had always an intermediate rib between the fasciated pair, whilst the bifurcated ribs alone prevailed in adult forms. He noticed that when the test was preserved the costæ were prominent, but they stood out very feebly on the mould, and sometimes disappeared altogether from the area; further, that when the aperture possessed the termination of the oral appendage the mouth of the shell had a much smaller diameter than the rest of the whorl.

Affinities and Differences.—This shell differs from *Stephanoceras Braunianum* (Pl. LXXXVI, fig. 4) in having inflated sides and a convex area; in the ribs on the sides being shorter, and in the general costation being neater.

[1] 'Paléontologie Française, Terr. Jurassiques,' tom. i, pp. 333.

Locality and Stratigraphical Position.—I collected three specimens of this shell many years ago from the Upper Lias clay at Stinchcombe Hill. I also obtained one small tolerably perfect specimen from the Upper Lias sands at Nailsworth. The species appears to be rare in Gloucestershire, seeing that I have never met with it in other collections.

STEPHANOCERAS BRAUNIANUM, *d'Orbigny*. Pl. LXXXVI, figs. 3, 4; Pl. LXXXVII, figs. 5, 6.

AMMONITES BRAUNIANUS, *d'Orbigny*. Paléont. Fr., Terr. Jurass., t. 104, fig. 3, 1842.

— — *Chapuis et Dewalque*. Mem. Cour. Acad. Roy. Belgique, t. xxv (Foss. du Luxembourg) pls. vi and vii, fig. 2, 1854.

STEPHANOCERAS BRAUNIANUM, *Tate and Blake*. Yorkshire Lias, p. 300, 1876.

Diagnosis.—Shell discoidal, compressed; area round, flat; whorls quadrate, slightly involute, transversely costated; costæ thirty-six to forty, straight, simple, approximate, externally mucronated near the margin, and bifurcated over the area.

Dimensions.—Transverse diameter 35 millimètres; height of last whorl 12 millimètres; width of umbilicus 18 millimètres; height of aperture 10 millimètres; width of aperture 12 millimètres.

Description.—The shell of this species has a neat quadrate form, the outer whorl, is slightly involute, flat on the sides, which are covered with thirty-six straight, simple, acute ribs, which terminate in a point situated at the angle of the siphonal area; here the rib bifurcates, the two smaller costæ pass over the flat area and both form a curvature the convexity of which is directed forward. The siphonal area is flat and convex, provided with twice as many costæ as are seen on the sides. The spire is composed of depressed subquadrate whorls, which are only slightly involute. The section of the aperture is subquadrate, and slightly grooved by the return of the spire.

Neither of my specimens exhibit the suture-line. In Pl. LXXXVI, figs. 3, 4, I have figured a very perfect small example of this species (magnified $2\frac{1}{2}$ diameters) which displays the structure of the test very well.

Affinities and Differences.—In its general form it somewhat resembles *Stephanoceras commune*, but it differs from that species in possessing sharp prominent tubercles at the angle of the area, in the whorls being less in number, and in the costæ being coarser.

Locality and Stratigraphical Position.—My two specimens were both collected from lower sands at Nailsworth belonging to the upper portion of the Lytoceras Jurense bed, which is well developed there.

PLATE LXXVIII.

Zone of Stephanoceras commune.

Fig. 1. PHYLLOCERAS HETEROPHYLLUM, *Sowerby*. Side view, half natural size, showing the fan-like dwelling-chamber.

2. — — — Suture line magnified. British Museum.

The figured specimen was collected from the Upper Lias shales of Whitby.

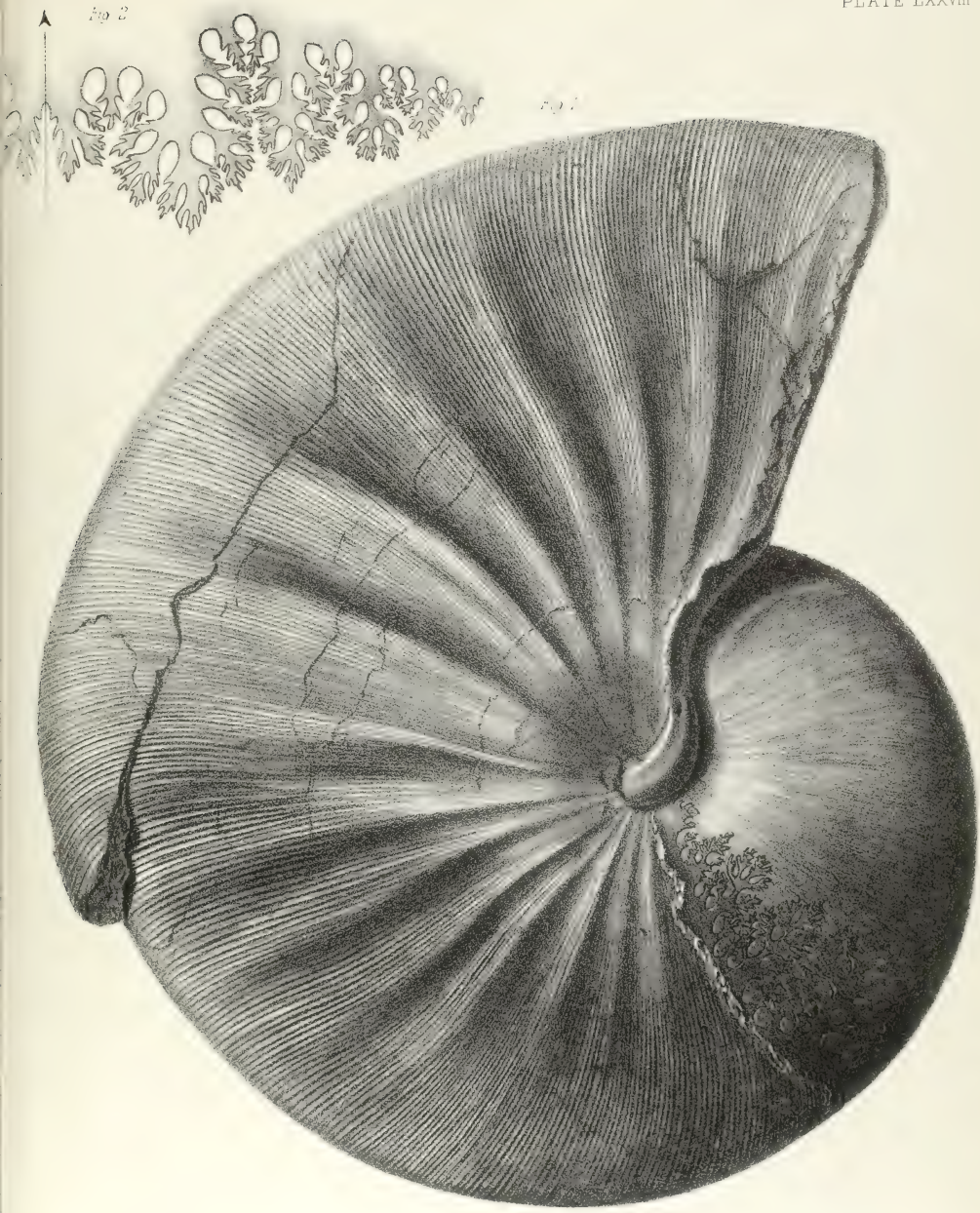

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PLATE LXXIX.

Zone of Lytoceras Jurense.

LYTOCERAS JURENSE, *Zieten.* Side view. This magnificent specimen, figured two thirds natural size, was presented to the Museum of the Royal School of Mines by the Earl of Enniskillen, D.C.L., F.R.S. The Ammonite had been sawn through to exhibit a vertical section of the septæ and chambers. There is no record of the locality from whence the fossil came, but from the petrological character of the rock I believe it was derived from the hard beds, Upper Lias, Dorsetshire.

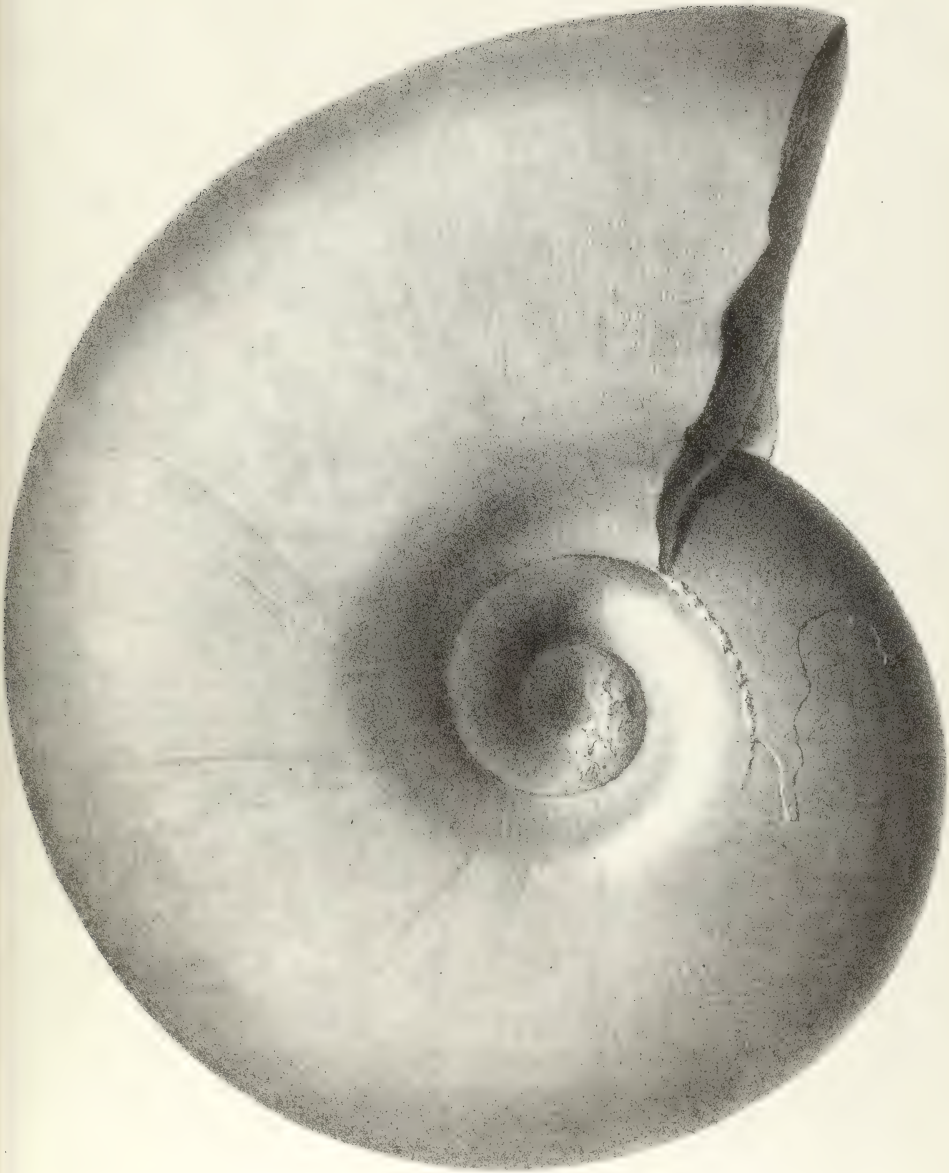


PLATE LXXX.

Zone of Harpoceras opalinum.

Fig. 1. HARPOCERAS AALENSE, *Zieten.* Side view, natural size, with shell. Adult form, Coaley Wood. My collection.

2. — — — Front view of the same do. do.

3. — — — Suture line of do. magnified.

4. — OPALINUM, *Reinecke.* Side view, natural size. Frocester Hill. My collection.

5. — — — Suture line of do. magnified.

6. — — — Large specimen, natural size. My collection from Haresfield.

7. — — — Front view of the same, natural size.

8. — — — View of siphonal area.

Fig 1

Fig 2

Fig 4

Fig 3

Fig 5

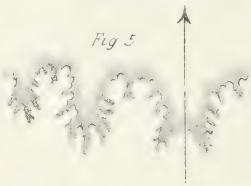


Fig 6

Fig 7

Fig 8

PLATE LXXXI.

Zone of Stephanoceras commune.

Fig. 1. PHYLLOCERAS SUBCARINATUM, *Young and Bird.* Side view. Natural size, with shell preserved. Whitby. My collection.

2. — — — Front view of the same do.

3. — — — Siphonal area, with sulci and carina.

4. HARPOCERAS RADIANS, *Reinecke.* Side view, natural size. Upper Lias shale, East Brent Knoll, Somerset. My collection.

5. — — — Siphonal area and carina.

6. — — — Front view with carina and ribbing.

Fig 2

Fig 1

Fig 3.

Fig. 5

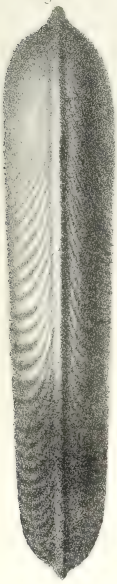


Fig 4.

Fig. 6

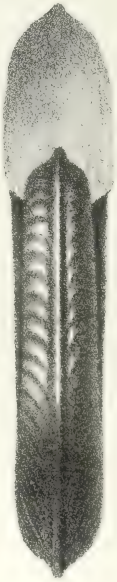


PLATE LXXXII.

Zone of Lytoceras Jurense.

Fig. 1. HARPOCERAS AALENSE, *Zieten.* Side view, natural size. Lyt. Jurense Bed, Wasserelfingen, Germany. My collection.

2. — — — Front view, do. do. do.

3. — — — Side of another specimen do. do.

4. — — — Siphonal area, do. do. do.

5. — COSTULA, — Side view, natural size. Variety with coarse ribs, from my collection. Wasserelfingen.

6. — — — Variety with fine ribs, from my collection. Frocester Hill.

7. — ACUTUM, *Tate.* Side view, magnified two diameters. Chipping Warden, Northamptonshire. My collection.

8. — — — Front view, do. do.

9. — BICARINATUM, *Münster.* Side view, natural size. Coaley. Collection of Museum, School of Mines.

10. — — — Front view, do. do.

10 *a*. — — — Suture line, magnified.

11. — — — Front view of a specimen copied from d'Orbigny, 'Pal. Franc. Jurass.,' pl. 114, fig. 3.

12. — DISCOIDES, *Zieten.* Side view, natural size. Coaley. My collection.

12 *a*. — — — Suture line, highly magnified.

13. — — — Front view, natural size. My collection.

14. AMALTHEUS LENTICULARIS, *Young.* Side view, natural size. Whitby. Collection of Museum, Royal School of Mines.

15. — — — Front view, do. do.

Fig 1.

Fig 2.

Fig 3.

Fig 4.

Fig 5.

Fig 6.

Fig 12 a.

Fig 12.

Fig 13a.

Fig 13.

Fig 8.

Fig 11.

Fig 10.

Fig 9.

Fig 14.

Fig 15.

Fig 16.

PLATE LXXXIII.

Fig. 1. Harpoceras Normanianum, *d'Orbigny*. Side view. British Museum.
2. — — — Front view.
3. Stephanoceras commune, *Sowerby*. Side view. British Museum.
4. — — — Front view.

Fig 1.

Fig 2.

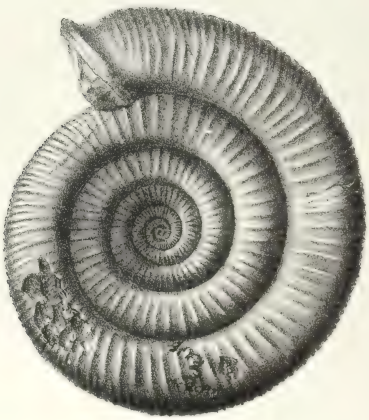


PLATE LXXXIV.

Fig. 1. STEPHANOCERAS COMMUNE, *Sowerby*. Side view, natural size. My collection.

2. — — — Front view of the same shell.

3. — — — Suture line highly magnified.

4. HARPOCERAS STRIATULUM, — Side view, natural size. My collection. Collected by myself from the "*Lytoceras Jurense* zone," Peak.

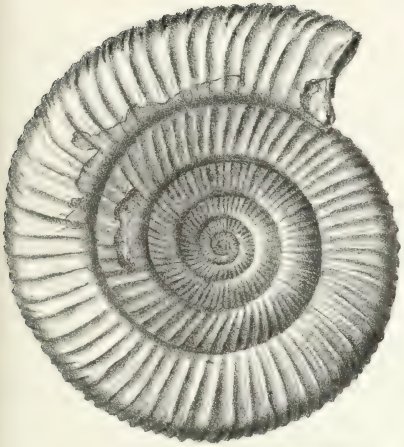
5. — — — Side view, natural size. My collection. Collected from the "*Lytoceras Jurense* zone" at Frocester Hill.

6. — — — Siphonal area, showing keel and costæ. My collection.

7. STEPHANOCERAS ANNULATUM, — Side view, natural size. My collection.

8. — — — Front view of same shell, with oral aperture.

9. — — — Portion of the suture line magnified.



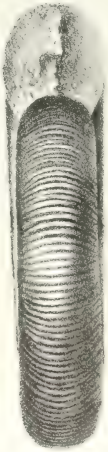


PLATE LXXXV.

Zone of Stephanoceras commune.

Fig. 1. STEPHANOCERAS SUBARMATUM, *Young*. Side view of a variety from Whitby, exhibiting the close relationship existing between this species and some varieties of *Stephanoceras fibulatum*. Natural size. My collection.

2. — — — Side view, natural size, from Upper Lias of Chipping Warden, Northamptonshire, showing the spinous inner whorls, and the smooth, bifurcate costæ of the outer whorl.

3. — — — Siphonal area of same shell, displaying its breadth and costation.

4. — — — Suture magnified.

5. STEPHANOCERAS FIBULATUM, *Sowerby*. Large inornate shell, side view, showing the oral aperture. My collection.

6. — — — Siphonal area and apertural expansion of same specimen.

7. — — — Side view of another example, showing very well the "button and loop" style of costation so characteristic of the species.

8. — — — Side view of the variety termed *Andreæ*.

9. — — — Portion of side of a rotund variety whose costæ are sharp, and possess pointed spines unfibulated.

10. — — — Siphonal area of a specimen collected from the Upper Lias of the Dowdeswell Tunnel, showing tubercles and transverse costæ.

11. — — — Side view of a specimen from same bed and locality. The fossil is identical with *Am. Bollensis* of Quenstedt.

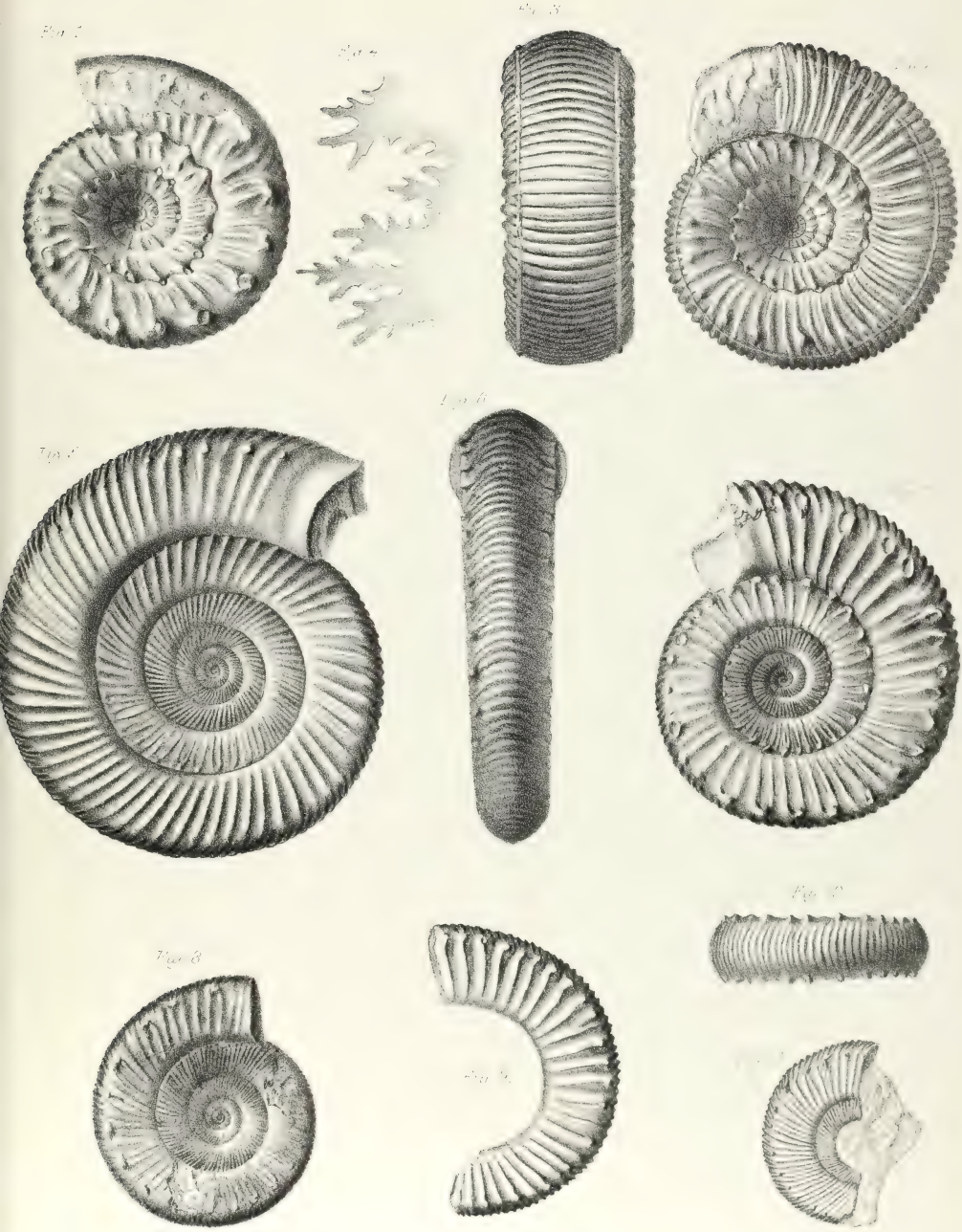


PLATE LXXXVI.

Zone of Stephanoceras commune.

Fig. 1. STEPHANOCERAS CRASSUM, *Young.* Side view, natural size. Whitby. My collection.

2. — — — Front view siphonal area and oral aperture.

3. — BRAUNIANUM, *d'Orbigny.* View of siphonal area magnified two and a half diameters. My collection.

4. — — — Side view of same shell, showing tubercles and costation magnified two and a half diameters.

5. — RAQUINIANUM, — Siphonal area magnified two diameters, with suture line *in sitú.* Nailsworth. Upper Lias Sands. My collection.

6. — — — Side view of the same fossil, showing the position of the tubercles and lateral costæ; two diameters.

7. — — — Front view of the same, showing regular transverse costæ.

8. — CRASSUM, *Young.* Large, well-developed specimen showing siphonal area, thick transverse costæ, and lateral tubercles *in sitú.* Whitby. My collection.

9. — — — Lateral view of the same fossil, showing the strong costæ and thick whorls.

10. — — — Front view of the same shell, showing transverse costæ and oral aperture.

PLATE LXXXVII.

Zone of Stephanoceras commune.

Fig. 1. STEPHANOCERAS RAQUINIANUM, *d'Orbigny*. Natural size, showing the siphonal area and transverse costæ. Stinchcombe. Upper Lias Clay. My collection.

2. — — — Side of the same fossil, natural size.

3. — — — Front view, showing transverse costation and oral aperture.

4. — — — Wide siphonal area, natural size. Stinchcombe. Upper Lias Clay. My collection.

5. — BRAUNIANUM, — Side view, natural size. Stinchcombe. My collection.

6. — — — Siphonal area of the same shell.

7. — RAQUINIANUM, — Side view, natural size, with fine costæ and small tubercles. Stinchcombe. My collection.

8. — — — Siphonal area of the same fossil.

9. — COMMUNE, *Sowerby*. Shell preserved, natural size, from Upper Lias, Chipping Warden, Northamptonshire, where it is known as *Am. Holandrei*, d'Orbigny.

10. — — — Side view, natural size, of the same fine specimen in the collection of Mr. Edwin A. Walford, F.G.S., Banbury, who kindly communicated it for figuring in this work.

Fig 1

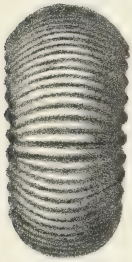


Fig 2

Fig 3

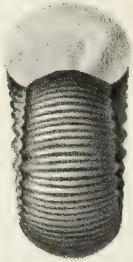


Fig 4

Fig 5

Fig 6

Fig 7

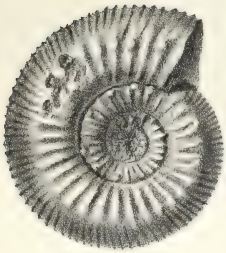
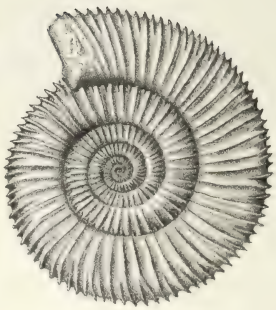


Fig 8

Fig 9

Fig 10



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